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THE STATUS OF THE ENGINEER.

The midwinter convention of the American Institute of Electrical Engineers has now become an established institution. While the succeeding conventions have lacked the inspiration of the first one, they have nevertheless, fully justified their existence. At the third one of these conventions, held last week in New York City, the interest seemed somewhat slack, except at the one evening session and at those on the closing day. The subject of "Electrical Porcelain" drew out quite a lengthy discussion, and the subject of "Electrical Precipitation" called forth a great deal of interest, the attendance at this session being augmented by many members of the American Institute of Mining Engineers, which had just concluded its convention.

The meeting on Wednesday evening, at which the status of the engineer was discussed, brought out an attendance which almost completely filled the first floor of the large auditorium of the Engineering Societies Building. In addition to the opening address of Mr. Lewis B. Stillwell, the presidents of the two largest electrical manufacturing corporations in the country, two professors of engineering who are also closely in touch with practical engineering work, and two engineers engaged in active and responsible work, contributed to the discussion of this subject. This discussion proved most interesting, and while different slants were given to the subject by the different speakers, there were many conclusions which were undisputed. One of these was that the engineer does not have the recognition which his work deserves, and does not take as prominent a part in civic affairs as he should. For these conditions he is himself responsible. That the engineer has been called into large affairs more generally as an expert and employee, rather than as an administrator, employer or executive official, is largely a matter of personal qualifications, rather than professional relation. The training of the engineer encourages his absorption in the details of technical work and discourages his study of the human element entering into large social problems, and into the handling of men. The engineer's training, especially as it is concerned in colleges and technical schools, should deal more generally with fundamentals, not only of applied science, but of subjects like psychology and economics, which have so great a bearing in practical enterprises. This is being appreciated, as is evidenced by the new courses at Johns Hopkins University, University of Pennsylvania, and elsewhere. For successful leadership, personality, breadth of view, human understanding, and other non-professional qualities are essential, and these are, if anything, less likely to be

found in the engineer than in the lawyer or business man.

It seems an open question whether many men who pass under that name and who are undoubtedly technical experts, should really be classed as engineers in the larger sense of that word. We recall the statement by the official of a large railroad corporation, that, given the requirements for a definite type of bridge, length of span, and other necessary details, it is quite easy to find quantities of designers to work out the details of the bridge design on comparatively low salaries, but that it is rather difficult to find a man who could determine whether the given type of bridge was the best for the given circumstances.

If the conditions which are frequently complained of by engineers are to be altered, the remedy lies with engineers themselves. Recognition follows achievement, and greater interest in civic affairs will bring calls for greater activities along such lines. Cultivation of the necessary qualifications will also result in a more frequent choice for responsible executive positions.

CAUSE AND EFFECT IN HUMAN AFFAIRS.

The admitted condition that the engineer is frequently lacking more than the average man in what may be classed as the human qualities, has been said to depend largely upon his mathematical training and tendency to apply mathematical analysis to his every-day problems, and to the fact that these problems deal in a large measure with inanimate nature. The properties of materials, their suitability for given uses, and their behavior under definite conditions, demand the greater part of his attention. He is concerned chiefly with the laws governing energy and inanimate matter. He realizes that inanimate nature obeys inexorable laws, and that a knowledge of these is sufficient to determine future action under any specified condition. The tendency to regard human beings differently seems to be due to our limited knowledge and breadth of vision. Human action and response also follow definite laws, but these laws have not been so exactly studied and formulated; actions have not been generalized.

A belief in the relation of cause and effect is necessary to the sanity of the individual and its existence is necessary to a sane world. This is fully recognized to the extent to which such relations are known. No well informed person questions the ability of the astronomer to prophesy the occurrence of eclipses, because astronomical laws are comparatively simple and well understood. Electrical laws have reached a somewhat similar stage of familiarity, and we can predetermine with fair accuracy under what conditions an electrical discharge will take place. The laws of meteorology are not so well understood, and the prognostications of the weather man are generally regarded as somewhat unreliable although in the long run the general condition of the weather can be foretold several days in advance. Those who understand psychological laws can fairly well predict mass action under given circumstances. Surely only a more exact knowledge than we now possess should be necessary to foretell what is going to happen to any given individual.

The laws of the inanimate world are fairly well understood. Given the present configuration of any material system, the velocity of each particle, and the present partition of energy, and the condition at any future moment can be determined either with or without the interference of external forces, providing these forces are specified. If we admit the same relation of cause and effect in human affairs, then the future thought and action of any individual must be determined by his present elements and his future environment, and only a lack of the necessary knowledge of these present elements, of the future conditions, and of the laws involved interferes with the ability to prophesy his entire future. The materialist at least must accept this, and admit that an omniscient intelligence could predict everything that will occur in the future.

EXPERT TESTIMONY.

One phase of the engineer's activities which was not touched upon in the Institute's discussion of the status of the engineer, was with respect to expert evidence. The training of the engineer encourages honesty. He must necessarily be honest with nature, and unless he is honest with himself he is doomed to failure. It becomes almost second nature to be honest with his fellows, and to seek truth in all relations of life. It seems entirely inconsistent with this natural attitude of the engineer that he should be called into court proceedings as an expert, paid by one of the litigants, and expected to hold the attitude of an advocate for that one. Unquestionably the testimony of many engineers under such circumstances is not determined alone by the circumstances of the case, but is largely influenced by the side which he has been called upon to support. Such an attitude not only is inimical to the determination of justice, but it greatly lowers the esteem in which the expert is held by the public. It is commonly believed that a so-called expert can be obtained to furnish any line of testimony that may be desired by a litigant, and this applies not only to engineers, but all professions.

This is certainly not as it should be. Engineers should take a hand in revising court practice so that the participation of the engineer in a case should have the effect of clearing, rather than befogging, the issue to be determined. To this end the remuneration of expert witnesses should be determined by the court, just as in the case of other witnesses, and payment should be made by, or at least through, the court. Of course a litigant should be privileged to subpoena any witnesses that may be desired, but if it is regarded as bribery to pay money directly to other classes of witnesses, there is no reason why it should be differently regarded in the case of the expert. The evidence required of experts is frequently judicial in its character, rather than an element in the determination of fact. Not only should such witnesses come into court as disinterested contributors to the determination of the true relations of a case, but the Court should also be privileged to call

upon technical advisers to elucidate points which do not come within his own range of knowledge. Indeed, it would seem quite advantageous to use, in cases involving technical points, a procedure often used in other cases, namely, that of permitting a master to take testimony and analyze it for the benefit of the court, leaving it to the judge to pass upon points of law.

REFINEMENT IN ELECTRICAL SERVICE.

There seems to be no end to the possible applications of electricity for human convenience. Many of the later developments require but small amounts of energy, but they advertise the service admirably, yield revenue to the manufacturer, jobber and retailer, and in widespread installations add something to the income of the central station.

A one-watt lamp has been developed abroad and is being designed in this country for use on the drop head of a sewing machine, just above the needle. When installed, this device combines "safety first" with a more rapid production of worked-up cloth due to the concentrated lighting and to the time saved in threading the needle. In factories using many machines this little device is bound to find extended use, provided it works out satisfactorily under service conditions. Now such a contrivance is almost insignificant from the standpoint of energy sales, even on a large scale of use, but like the microscope lamp, the pocket flashlight, the hospital miniature signal lamp and a host of other tiny but convenient equipments, it is a constant source of education to the user of its service as to the value and low cost of "doing it electrically."

Sick animals are now transported to the hospital in electric trucks, and the undertaker with night office at his home, is turning to electricity to guide the afflicted to his doorbell in their hours of trial. In the factory yard, the permanent lighting of auxiliary fire-alarm boxes by low-powered incandescent lamps burning day and night is coming into vogue, and on city streets, the use of tungsten lamps inclosed in red shades or globes above alarm boxes is adding much to the convenience of the public and the speed of giving the fire department news of trouble in the first few moments which count so much in this work. In almost every new institution for public or semi-public service one will find new or at least comparatively unfamiliar applications of electricty, such as the small motor for stirring calorimeters in the coal-testing laboratory, the installation of electric transparencies to call instrument boys from the stock room to the operating chair in the clinic, and many other useful contrivances.

All of these are interesting because of their possible adaptation to other conditions of service, and although as stated above, small in individual energy consumption, they are well worth the study of central-station men and supply dealers, contractors and jobbers through the part they are capable of playing in the greater popularization of electricity.

STUDYING THE DISTRIBUTION SYSTEM.

In the future efficiency work of central stations, more attention will be paid to the study of distribution systems. The pursuit of station economy is just as worth while as ever, but in many companies, the investigation of line losses and circuit arrangement is a virgin field for the engineer.

A recent examination of line losses, including transformer primaries, in several central-station systems under a common management, showed distribution losses varying from 8 to 31 per cent. The combined yearly output of all the companies was 71,500,000 kilowatt-hours. At a meeting of company managers it was pointed out that a five-per-cent reduction in these losses would save the combined systems $17,000 a year, and the proposed line of attack included a comprehensive study in each company of the existing lines as compared with an ideal layout, a system of pole numbering along geographical lines, the specialization of pole-reinforcing gangs, and establishment of a complete card record of every pole on the system.

The great majority of distribution systems are the result of many years' growth along lines of least commercial resistance. Only in new towns does one find the line layout occasionally approximating the engineering ideal. Yet it is desirable for a central station to make a theoretically attractive line layout on a fairly large-scaled map, and as changes in the existing system become necessary, to try to make them as far as possible in accordance with the ideal installation. Perhaps nowhere in central-station practice are rule-of-thumb methods more generally followed than in line maintenance and relocation, and doubtless the comparative inaccessibility of this part of the equipment is responsible for the frequent lack of scientific treatment observed. Loads are often transferred between circuits without a proper study of the losses incurred, and there is no question that the load distribution of a good many overhead lines is poor, leaving some parts of the system with a heavy surplus of copper and other parts with voltage drops which might be decreased with benefit both to the consumer and to the showing of the company's energy balance sheet.

Scrutiny of watt-hour meter records on outgoing circuits compared with the consumers' totals is a practice worth cultivating more generally, as is the more systematic planning of pole reinforcement and preventive maintenance in particular districts by specialized gangs. Better records of the distribution system are desirable, also, with responsible checking of new construction with record plans or loose-leaf sheets. In making inventories, substantial discrepancies are often found between line records and the equipment required to serve customers in the field. There is also room for improvement in transferring records of linemen's work to the distribution sheets of the office. A little more systematic planning will go a long ways toward the realization of better efficiency on the distribution lines of many companies.

Panama-Pacific International Exposition Opens to Record-Breaking Attendance.

The Panama-Pacific International Exposition opened in all its magnificence on Saturday, February 20. The gates opened officially at 9 o'clock Saturday morning and the exposition will remain in full swing until Saturday, December 4, 1915. President Wilson performed the official act of pressing the button which set the exposition machinery in motion. It is estimated that some 300,000 visitors attended the exposition during the first 24 hours after the gates were officially thrown open.

Forty-three states and 42 foreign nations are represented officially. Other nations are represented by individual exhibitors, and there is a greater diversity and more comprehensive representation than has ever been presented at any other exposition in history. The investment represents $50,000,000. The concentration to the exhibit palaces is a triumph of ground plotting. Machinery Hall is the largest frame building under one roof in the world. Transportation facilities are available to handle 50,000 visitors an hour to and from the exposition gates.

The exposition covers an area of two and one-half miles in length by one-half mile in width along the shore of San Francisco Bay. The foreign pavilions and exhibits represent an outlay of $10,000,000, the state buildings and exhibits another $10,000,000, and the capital invested in the amusement zone totals still another $10,000,000.

Readers of the ELECTRICAL REVIEW AND WESTERN ELECTRICIAN are familiar with the construction details and the arrangement of the various buildings. The remarkable lighting effects have also been fully described in these pages. The illumination of the exterior of the buildings has attracted widespread comment for its utility and beauty. Never before has an illuminating scheme been worked out on so extensive a scale, and never before has artificial illumination been handled to produce such unique and startling effects.

Rejuvenation in New York.

On March 3 the New York Jovians will hold a rejuvenation at the Hotel Martinique. James H. Betts, statesman for New York, has taken active charge of the membership campaign and anticipates a class of 100 candidates. A dinner and cabaret, starting at 7 p. m., will precede the initiation ceremonies. C. L. Hight is in charge of the degree work. Frank E. Watts is Tribune for New York City.

Electric Club of Chicago.

J. M. Dickinson, former Secretary of War, delivered an address before The Electric Club of Chicago on February 18, on the subject of "Armament and Disarmament." He called attention to the present crisis which this country is facing, and commented at some length on the unpreparedness for war. Extracts were read from a report recently submitted by the chief of staff of the United States Army pointing out the inferior facilities for carrying on a struggle with any first-class nation.

At the conclusion of the address, President Pinckard appointed a committee to confer with the officers of the Western Society of Engineers for the purpose of determining in what way the Electric Club could co-operate with the former organization in the formulation of a definite plan for co-operation with the Engineer Corps of the United States Army. Preliminary steps have already been taken by the Western Society of Engineers for the accomplishment of this end.

British and American Engineers to Confer on Standards.

H. M. Hobart and C. E. Skinner, representing the United States National Committee of the International Electrotechnical Commission, have gone to London for an informal conference with the British members of the Commission. Differences in the views of the two committees will be discussed, especially with reference to the portions of the Standardization Rules of the American Institute of Electrical Engineers, which are not acceptable to the British committee.

The meeting of the entire International Electrotechnical Commission, which was planned to be held next September at San Francisco, has been abandoned.

Electroplating with Cyanide Solutions.

At the Lewis Institute, Chicago, Ill., on the evening of February 11, the Roessler & Hasslacher Chemical Company provided a practical demonstration of electroplating with solutions of metal cyanides.

After some introductory remarks by Prof. P. B. Woodworth, Dr. Dittmar made a general address on the subject, pointing out the importance of pure chemicals and the conditions for greatest efficiency.

Dr. Weber then read a technical paper pointing out the advantage of using a pure solution of copper and sodium cyanides for copper plating. Although the cost per pound for copper cyanide is higher than for other salts, it was shown to be cheaper in the long run.

Mr. Proctor then gave demonstrations of actual plating of copper and brass upon steel, using solutions of the metal cyanides. The concentration used was 13.5 ounces each of copper cyanide and sodium cyanide in 4.5 gallons of water, for copper plating. The best temperature is about 70 degrees centigrade and current densities may be used up to a maximum of about 30 amperes per square foot. For brass plating equal quantities of zinc and sodium cyanides are dissolved and mixed with the same quantity of the copper plating solution, adjustment of water being made to give 2.6 ounces of metal per gallon.

Standardizing Plugs and Receptacles.

At the call of the chairman of the Committee on Wiring Existing Buildings, National Electric Light Association, a meeting of the manufacturers of plugs and receptacles was held in the N. E. L. A. headquarters in New York on Monday, February 15, at which the following companies were represented: Metropolitan Electric Manufacturing Company, General Electric Company, the Bryant Electric Company, Arrow Electric Company, Hubbell Electric Company, Hart & Hegemann Manufacturing Company, H. T. Paiste Company, Manhattan Electrical Supply Company, Trumbull Electric Manufacturing Company, and Freeman Electric Company.

After considerable discussion it was decided that further progress in standardizing and making interconnectable plugs and receptacles was possible and desirable, and the meeting adjourned to March 4.

New England Question-Box Meeting.

The special Question-Box convention to be held by the New England Section of the National Electric Light Association, in Boston, Mass., next month, has been set for March 11 and 12, instead of March 9 and 10, as originally announced. The meeting will be held at the American House in Hanover Street and is aimed to bring central-station and electric-vehicle men together for reciprocal answering of many questions of mutual interest.

At the meeting of the New York Electrical Society on February 17 Putnam A. Bates, electrical engineer of the New York Fire Department, gave a most able exposition of the weakness of the city fire-alarm system in the past, its present strenuous steps towards reorganization, and its plans for the future.

Electricity in Paper Making.

By W. B. Conant.

The extensive use of electricity in the manufacture of paper is the natural outgrowth of the conditions under which that commodity is produced. In many cases, paper mills are located on or near the rivers by which the pulp-wood is brought down from the forests. Maine, Pennsylvania, West Virginia and Wisconsin, are four important paper-making states, and here are found water-powers which provide both mechanical drive for pulp grinding and water-generated electric power for other machine and chemical processes of paper manufacture.

This article discusses the processes involved in paper making and the characteristics of the motors necessary to fulfill the requirements. Two modern typical plants are treated in detail and tabulated data given on the motor equipment in each.

While a large amount of wood-pulp paper is manufactured by the process of grinding the wood into pulp, much of the better grades of pulp paper is made by the chemical process, i. e., by disintegrating the wood by means of chemicals. Two kinds of wood are used—poplar and spruce. The former is disintegrated by the use of caustic soda, and produces what is called soda pulp; the latter wood is disintegrated by means of sulphurous acid, and produces sulphite pulp. By combining the two kinds of pulp, sulphite for strength and soda pulp as a filler, the "stuff" or material for a strong and white paper is obtained.

The bleaching process, by which the pulp is whitened, is performed by electrolytic action, in which low-voltage, direct-current energy is employed.

In a modern mill, after the pulp has been produced it is clarified, bleached, boiled and then beaten and thoroughly churned to mix the ingredients. Usually six or eight beaters and one refining machine are operated to supply a sufficient quantity of pulp to each paper machine having a capacity of 30 tons a day.

After beating, the "half stuff," as it is called, goes into a tank below the beater room and from there is pumped to a centrifugal churn called a Jordan engine, where it is further mixed and thinned by the addition of water. Then the material is carried by gravity to the machine chest in the basement, whence a pump forces it to the screen of the

Paper Machines Driven by Two Motors to Secure the Necessary Speed Variations.

While the heavy grinding of mechanically prepared pulp can be done to advantage by means of shaft-driven waterwheels, there are a number of processes which are much more efficiently performed by the use of electric motors. Of these, part are accomplished by constant-speed motors and others are performed to best advantage with the flexible speed that motors of the variable-speed type provide.

paper machine on the floor directly above. The "stuff," or fluid pulp, enters the paper machine in a state of 0.5 per cent solid, and after having been carried through a succession of rollers, part of them steam heated, emerges in the form of machine-finished paper, the time required for pressing and drying the sheet as it runs being about two minutes. Modern paper machines are provided with a hood and ventilator directly over the drying rollers to carry off the exhausted moisture.

Large quantities of "machine-finish" paper are used commercially, but there are refinements known as sizing, calendering and coating which call for further power applications. The process of coating paper is a distinct business, and here, as well as in the operation of the variable-speed motions of the paper machine, the motor of the direct-current type is finding wide application.

In mills making book and magazine paper, and also various special boards, the use of super calenders is necessary to give the desired finish to the stock.

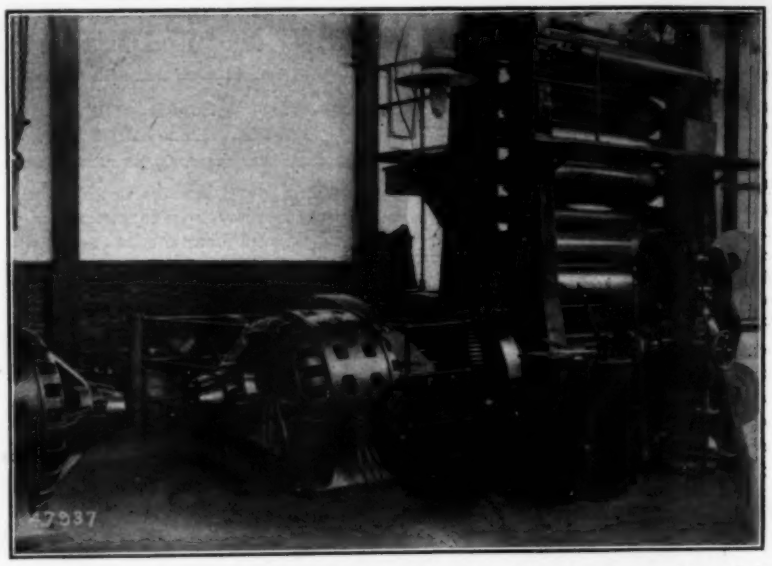
The principal requirements of a satisfactory calender drive are: (1) A slow and unform threading-in speed. (2) Gradual acceleration from low to high speed. (3) Ability to slow down, and accelerate again. (4) Simplicity of control and operation. (5) Simplicity of construction and greatest reliability.

With line-shaft drive the threading-in speed is entirely satisfactory, but the acceleration depends upon the condition of the friction clutch and is liable to be variable and uneven. Attempts to remedy this undesirable feature in line-shaft drive have led to various forms of motor drive. Only with motor drive is it possible to slow down and speed up again, and with coated paper or especially weak paper a large number of breaks are saved by varying the speed according to the condition of the paper. It is much easier for the operator to manipulate the controller than repair breaks in the paper, and the result is a large increase in production.

Motor drive makes possible the use of automatic stops from various parts of the calendar, which often prevent serious injury to the operators. The motor may be stopped from push buttons located in any desired position, and if manufacturing conditions require it, magnetic brakes may be used to assist in stopping the calender.

Maximum production is obtained by running each weight of paper at the maximum possible speed, but with line-shaft drive only one high speed is obtainable and this must be an average value to suit all conditions.

With motor drive it is possible to gear for the maximum speed desired, and when any paper will not stand this



Paper Machine Driven by Alternating-Current Motor—Speed Variation Secured by Clutch and Gear Reduction.

speed, a slower speed can be obtained by means of the controller. It is a fact, however, that a higher operating speed is maintained for all weights of paper with motor drive than with line-shaft drive, due to the gradual acceleration and the easy control of the speed.

Due to its advantages of distribution, alternating current is used rather generally in paper mills, and the simplicity and reliability of the induction motor makes its use for calenders almost universal. The wound-rotor type of motor is required, since, as above outlined, it is necessary not only to have gradual acceleration, but often to slow down and accelerate again at intervals.

The two-motor drive as shown in one of the accompanying illustrations, has been very widely used and meets all of the operating characteristics as outlined above. The threading-in speed is obtained from the small squirrel-cage motor through several gear reductions, and gradual acceleration is obtained by properly operating the controller of the large motor. By means of the controller, the speed of the calender can also be quickly reduced to allow the safe passage of weak spots or rough edges. If desired the controller and resistance can be so designed that continuous operation can be obtained at reduced speed, but unless a large variety of stock is run, the maximum speed can always be used.

In another view is shown a single-motor alternating-current drive in which the threading-in speed is obtained from the main motor by means of a clutch and gear reduction. The

Motor Driving Rotary Cutter in Paper Mill.

Data Sheet—Paper Manufacturing.

The Oxford Paper Company, Rumford, Maine, manufacturers of machine-finish, supersized and calendered papers.

The mills are partially motorized and the total horsepower in motors is 5,863. Total number of motors on Rumford Falls Power Company service, 36. Horsepower operated by water-wheel generator at mills, 197.

The average daily consumption of central-station energy per working day on a basis of 325 days a year, is about 100,000 kilowatt-hours.

MOTOR INSTALLATION.

No.	Horse-power	Voltage	Application.
1	450	2,200	Operates by rope drive six pulp beaters.
1	450	2,200	Operates by rope drive four pulp beaters, one Wag engine.
2	150	550	Operate two Wag refining engines.
5	100	2,080	Operate 10 pulp beaters, two on each motor.
5	125	2,200	Operate 10 pulp beaters, two on each motor.
5	480	2,200	Direct-connected to five generators supplying 220-volt direct-current energy to electrolytic bleach plant.
1	150	2,200	Belted to Jordan beater.
1	125	550	Operates constant-speed shaft on paper machine.
1	100	550	Operates constant-speed shaft on paper machine.
2	30	2,200	Operate exciters.
1	30	550	Operates water pump.
1	40	550	Operates water pump in screen room.
1	30	550	Operates chip conveyor from wood room to digesters.
1	50	550	Operates machinery in acid room.
3	12	550	Drives paper-machine fans for ventilation.
1	22	550	Operates conveyor.
1	2.5	550	Operates clay conveyor.
1	0.5	550	Operates fan.
1	50	550	Operates air compressor.
1	20	550	Operates saw in box department.
1	25	550	Operates planer in box department.
1	20	550	Spare motor.
1	20	110	Serves save-all tanks.
1	50	110	Serves cutter room.
1	15	110	Operates elevator.
1	50	110	Serves acid room.
1	15	110	Serves bleaching room.
3	15	110	Spare motors.
2	2	110	Operate fans.
4	30	110	Spare motors.
1	180	220	Drives variable-speed shaft on new paper machine.

The Maine Coated Paper Company, Rumford, Me., manufacturers of high-finish coated half-tone papers. Plant entirely motorized.

Total horsepower in motors, 362. Total number of motors, 18.

Horsepower of direct-current motors, 246; number of direct-current motors, 6. Horsepower of alternating-current motors, 116; number of alternating-current motors, 12.

Power-factor about 70; through motor-generator set, 90 to 95. Plant operates 10 hours per day.

MOTOR INSTALLATION.

The following is a list of motors installed and the machines they operate. The supply source is 250 volts direct current provided through motor generator, 2,300-volt, 40-cycle energy being derived from the Rumford Falls Power Company. Alternating-current motors are operated on 550 volts, through transformers, from the Rumford Falls Power Company.

No.	Horse-power	Type	Application.
3	15	Induction	Belted through shafting to six coating machines and moving racks for paper drying.
3	75	Variable Speed	Geared to three calender machines; controlled through drum controllers.
2	7.5	Variable Speed	Belted to two Hamblett cutting and jogging machines.
1	7.5	Induction	Belted to undercut (Smith & Winchester Company) press cutter, 87-inch knife.
1	6	Induction	Belted to shafting driving two circular saws, paper-cutter knife grinder, hack saw, emery wheel, drill press, two trimming machines.
1	3	Induction	Belted to baling machine.
1	6	Variable Speed	Belted to re-winding machine.
1	6	Induction	Belted to Vortex centrifugal pump for water supply.
1	10	Induction	Belted to air pump to agitate water in filter bed.
1	1	Induction	Belted to cylinder screen in water tank.
3	12.5	Special	Operate three two-ton freight elevators.

operating conditions and first cost are practically the same for the two-motor drive, except when the calender is run at the low speed for a considerable time. Under the latter conditions the use of a small motor is more economical.

The power required to drive a calender depends principally upon the number and width of rolls, the speed, the stock calendered, and the method of handling; each proposition should, therefore, be carefully investigated befor motors are applied.

A brief description of the motor uses in the paper mills of the Oxford Paper Company, at Rumford, Maine, which produces a train-load of print papers a day, is of interest. Following this, an account of the motor equipment of the Maine Coated Paper Company, whose plant, only lately completed, is located adjacent to the Oxford Company, will indicate the most improved practice in the business of paper coating.

The Oxford Paper Company's mills are supplied with power by the Rumford Falls Power Company, from its hydro-electric generating station about one mile distant. Energy averaging about 125,000 kilowatt-hours per day is generated here, and of this about 100,000 kilowatt-hours a day are used by the Oxford Paper Company, the connected load being about 5,300 horsepower. Much of the paper-mill machinery is operated 24 hours a day. A 11,000-volt transmission line brings the energy to a substation in the yard of the mills, where three 2,500-kilovolt-ampere step-down transformers, rated 22,000/2,300 volts, provide for power uses in the mills. Further transformers provide for 550-volt energy for subordinate motors.

The beating machines are operated from line shafting. There are two 450-horsepower variable-speed motors operated on 2,200 volts alternating current. These are connected with the shafting by rope drive, and the motors are installed in a separate compartment with a brick partition between them and the moist processes of pulp preparation. One of these large motors operates six beaters, and the other four beaters and a Wag refining engine.

In an adjoining mill are located five 100-horsepower induction motors, operating on 2,080 volts, and five 125-horsepower motors operating on 2,200 volts. Each motor drives two beaters. These 10 motors are located on a platform or gallery that extends through the center of the beater room about 10 feet above the floor on which the beaters are located. Each motor is connected by leather belt to the jack shaft from which a pair of beaters is operated, the pair of machines driven from each motor being in alternate positions on either side of the gallery. The placing of the motors thus in an elevated position keeps them out of the way and secluded from the reach of unfavorable influences of the pulp machines.

In connection with the 20 beaters are three Wag refining engines driven by two 100-horsepower and one 150-horsepower induction motors operating on 2,200 volts. Induction motors of 100 and 125 horsepower drive the constant-speed motions on the paper machines, those requiring variable speed being provided by belt-connected cone pulleys on shafting driven by steam engines.

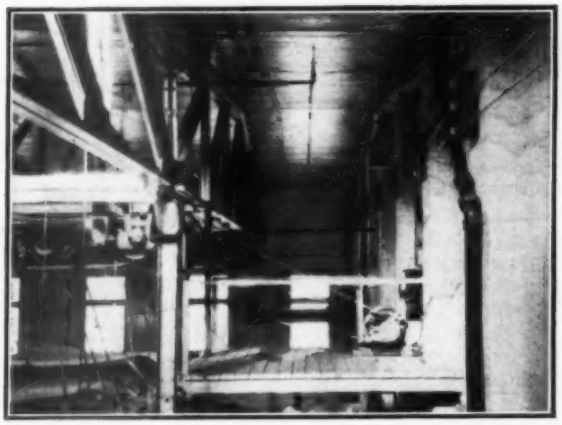
A brief description of the mode of operation of a new paper machine of 30 tons daily capacity, manufactured by Rice, Barton & Fales, Worcester, Mass., and now being installed in a new addition of the Oxford mills, will serve to indicate advanced practice in this operation.

Since steam is required for the roller drying of the paper as it passes through the machine, its further use is employed in operating the machine itself, but this is only in part by direct mechanical drive, the variable-speed motions being performed from motor drive on direct current.

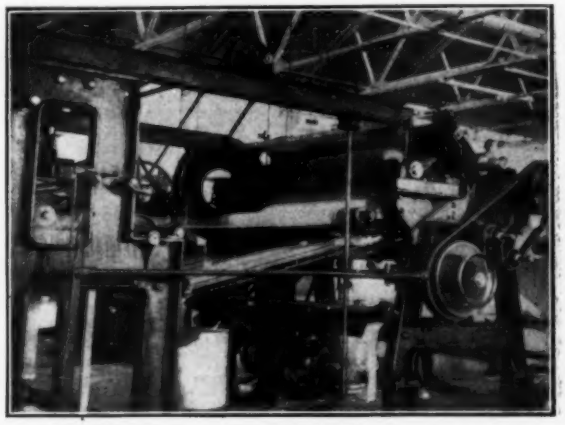
In the basement of the mill addition referred to is installed a 300-horsepower Corliss engine, direct-connected to a 150-kilowatt generator operating on the shaft which also carries the drum for rope-drive connection with the constant-speed shaft, and revolving at 120 revolutions per minute. The constant-speed shaft is mounted from the floor and extends the length of the basement, directly beneath the paper machine. Its function is the operation of pumps to supply "stuff" to the machine and to exhaust water from the paper in process. It revolves at 200 revolutions per minute, and its load is about 100 horsepower.

Parallel to this shaft is another shaft for performing the variable-speed motions on the machine. It operates all the rollers, and through cone-pulley connection provides for the slight diminution in speed of roller rotation as the finished end of the machine is reached. The explanation of this requirement is, that as the paper becomes drier and more solid, a slight contraction in the sheet occurs; hence each drying roll must lag a little behind its predecessor or the sheet will be torn by the strain.

The first, or constant-speed shaft is driven from the drum on the engine-generator shaft, as noted; the variable-speed shaft is driven by a 45-180-horsepower direct-current, variable-speed motor operating on 240 volts. Its rating is 45 horsepower on maximum speed of 360 revolutions per minute, and 180 horsepower on the minimum speed of 60 revolutions per minute. This speed range in the ratio of 1 to 6 is of great service in that it gives the opportunity for the largest possible production, some grades of paper allowing rapid runs and others slower. The desired speed, determined by the quality and thickness of the paper in process, is regulated from a control panel on the machine-room floor, through which the feed wires from the generator run. The control is had by means of a speed-regulating rheostat.



Coating Machines Driven by 15-Horsepower Motor Mounted on Platform.



Cutting Machine Driven by a 7.5-Horsepower Motor—Variable Speed.

From the constant-speed shaft a five-kilowatt belted exciter provides for excitation of the generator and the motor fields.

The electrolytic bleach-plant equipment remains to be noted. This consists of five 480-horsepower motor-generator sets which operate on 2,200 volts and supply 220-volt direct-current energy to the bleach tanks. The technicalities of the bleach process comprise the one jealously-guarded secret of the trade.

In connection with these motor-generators, a double set of two starting transformers are installed in the brick structure housing the machines.

The process of paper coating is carried on under specially favorable conditions at Rumford, and the new plant may be regarded as a model. The Maine Coated Paper Company's operations are briefly described as follows.

Taking the machine-finished paper as it comes in rolls from the paper machines of another company, it is fed to a series of brushes which apply a coating of clay and glue to each side of the sheet in succession. Other brushes in the series spread the liquid coating evenly, and thence the paper is carried onto a series of moving racks which hang the paper in long festoons and slowly carry it forward down the super-heated drying room. About 22 minutes are required to sufficiently dry the coating. The paper is then wound in large rolls and passed through a calender which is provided with heavy rollers, part of them bored and supplied with steam heat. The high finish of the superior product of this company is obtained by alternate iron and compressed cotton rollers, under great pressure.

The paper is rewound as it comes from the calender machine and passed through a machine which trims the edges, and if desired splits the roll into two strips.

One of the cutting machines then cuts the rolls into sheets of stock or of special sizes, and another cutter, of the single-knife pattern familiar to printers, is employed if stock sizes require further trimming or splitting. The paper is then counted in reams of 500 sheets, is inspected and packed in wooden cases for shipment.

The Maine Coated Paper Company operates about 66 per cent of its motors on direct current, for variable-speed service. In order to secure the most economical power load and "take up the slack" of the several machines, a special substation was installed in the mill, where energy derived from a small substation of the Rumford Falls Paper Company, on its 11,000-volt line, steps down the energy to 2,300 volts, whence it is fed to a motor-generator set for transformation to 250-volt direct-current energy.

The power-factor of the motor load is normally about 70 per cent, but by means of the motor-generator a power-factor of 90 to 95 per cent is obtained, which increase represents a substantial saving in the power bill.

A volume of about 200 amperes is handled through this motor, which is wound for 2,300 volts, 40 cycles, the horsepower rating being 290, and the speed 600 revolutions per minute.

The generator is rated at 200 kilowatts and is direct-connected. Three transformers are installed in this mill substation, for the operation of alternating-current motors on 550 volts. There are also two lighting transformers rated 2,300/115 volts. An electric automatic starter is provided, to bring the motor-generator set to speed before loading.

The Maine Coated Paper Company's coating-machine room is provided with six coating machines and their accompanying moving racks for drying the paper. These machines are operated in pairs, from overhead shafting, each pair being connected with a 15-horsepower motor installed on a platform about 12 feet above the floor and provided with oil switch, with overload and low-voltage release.

In the calendering department there are three machines for surfacing the paper, each operated by a 75-horsepower variable-speed motor on 230 volts direct current. The connection with each machine is through gears. The motors' speed variation is 400-800 revolutions per minute. Control is had through a drum controller near the operating lever of each calender. The variable-speed feature gives the operator control over the joints and breaks in the paper rolls, and enables him to pay it fast or slowly through the calendar, thus avoiding the risk of tearing the sheet. The top speed of the paper as it passes through the calender is 800 feet per minute. Threading-in the paper calls for the lowest speed.

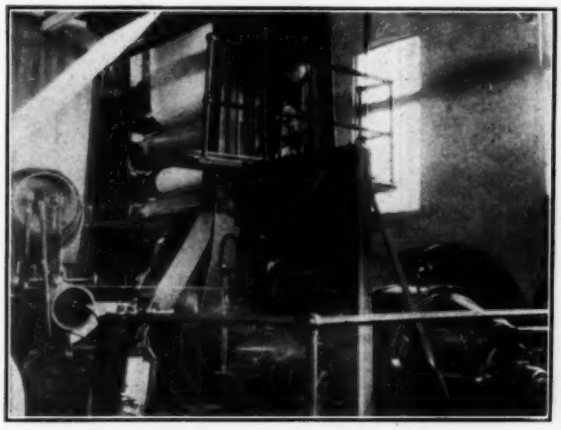
The two cutting and jogging machines operated in the finishing process are each driven by a 7.5-horsepower direct-current, variable-speed motor located under the machine, on the floor. The same merit in speed control obtains as in the case of the calender machines.

An 87-inch press cutter, used in trimming and splitting reams, is belted to a 7.5-horsepower induction motor, variable speed not being a requisite to performing this process.

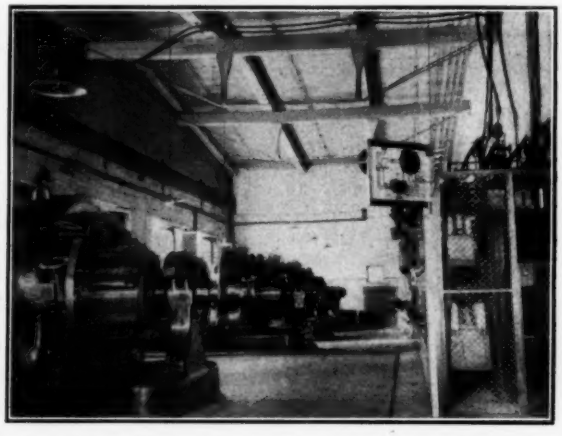
In the basement is the box-making department. Here packing cases are made of one-inch spruce lumber. A six-horsepower induction motor runs the woodworking machines and a paper-cutter knife grinder. A baling machine for compressing the edgings from the trimmed paper rolls is located in the basement at the foot of a chute from the cutting machines and is driven by a three-horsepower induction motor.

A second rewinding machine is an auxiliary, used for trimming rolls and splitting them, and this is driven by a six-horsepower variable-speed motor.

A centrifugal pump with a capacity of 200,000 gallons per day supplies water from the river to the entire mill. This is operated by a six-horsepower induction motor.



Calender Driven by 75-Horsepower Motor.



Group of Motor-Generator Sets in Paper Mill.

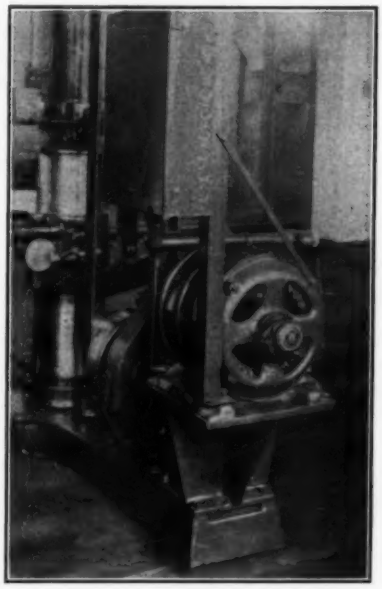
Commercial Practice
Management, Rates, New Business

Special Lighting Improvement Proposed for Utah.

A bill has been introduced by Senator Eckersley into the Utah Legislature providing for the creation of special lighting improvement districts under which the property owners on any street or sub-division may petition the City Commission to create special lighting improvement districts, to install therein lighting systems, and to assess the cost of installation and operation against the property benefited. The passage of the bill is being urged by the State Street Improvement Assosociation, and the Upper Main Street Association of Salt Lake City, both of whom are desirous of installing elaborate decorative lighting systems preparatory to the coming of tourists to Salt Lake City on their way to the Panama-Pacific International Exposition. Special lighting systems have been attempted on both of these streets on the voluntary payment basis, but it has proven impossible to maintain them on the scale which was originally planned, owing to the fact that many merchants and property owners refuse to keep up their assessments. It is believed that if this bill passes the Legislature and is approved by the Governor, that at least six or seven miles of special street lighting will be installed in Salt Lake City and Ogden early in the spring.

Increasing the Efficiency of a Motor Drive.

Attention to details in arranging for the motor driving of machine tools marks the best practice of today. It is often necessary for the tool purchaser to care for details beyond the consideration of the builder, as illustrated in the accompanying illustration. Here a drill press fitted with a two-horsepower motor is provided with an automatic starting and stopping push button shown at the left and upper portion of the view, the main motor switch being located in the large metal cabinet in the upper foreground. Behind the switch box is a solenoid switch which is actuated by the push-botton control circuit. The motor is of the two-phase induction type, and one wire in each phase is carried through the solenoid switch contacts, so that whenever the operator wishes to stop the motor, a push of the button breaks two of the "legs" of the motor field circuits and standstill soon results. A second push restores the solenoid contacts and starts the motor. The solenoid circuit, run in flexible metal conduit, is energized from an independent 110-volt service in the shop, the motor being on a 220-volt circuit. The installation of the push button saves the operator's time, as without it he would frequently be obliged to leave the face of the tool



Unique Method of Mounting Motor to Increase Efficiency.

and go to the switch box to start and stop the motor. The illustration clearly shows the convenience of angle-irons and narrow strap irons in mounting switch boxes, and the inclosure of the motor circuit in conduit even between the switch box and the motor terminals, with the gear and pinion guard attached to the bedplate by a short piece of iron strap form effective safety features.

The Central-Station Influence on Chicago of the Future.

The Commonwealth Edison has prepared and is distributing a large halftone reproduction of an artist's conception of an aeroplane view of Chicago. The view pictures the lake front and business district as it would appear if the contemplated improvements were made. It is pointed out that over 95 per cent of the buildings in the business section of the city, which use electricity, are furnished with energy from the Commonwealth Edison Company. In the letter which accompanies the illustration, the company says: "The picture graphically illustrates the Spotless Town which would result from the general adoption of central-station service; in reality a city of cleanly beauty. And the wider employment of central-station power would mean an actual saving to hundreds of power users now making their own electricity.

"Certainly, Chicago the clean city, is a civic ideal for which to strive and the constantly increasing use of Edison Service would indicate that some day it would be a reality rather than an ideal."

Co-operative Meeting in Allentown to Stimulate Power Business.

As an illustration of the possibilities of an N. E. L. A. Company Section to render the utmost service to its individual members and to the central-station company which it represents, the regular meeting of the Lehigh Valley Light & Power Company Section, held on February 2, at Allentown, Pa., exemplified the perfect co-operation between the utility company, its employees and one of the largest consumers on the company's lines.

By arrangement with the management the meeting was held in the silk mill of Kaltenbach & Stephens, conceded to be one of the finest and up-to-date, though not the largest mill in the country. All prospective power users in the silk industry from the entire territory were invited to attend, and textile experts from various electrical manufacturing companies were on hand to explain the advantages of the electric drive over all other forms of power.

The entire audience was seated in an open space adjourning the boiler room, by which the plant is heated in winter, and here short illustrated talks were given by Lindsley Vogel, of the Westinghouse Electric & Manufacturing Company, and C. A. Bear, of the General Electric Company. They covered the general methods used in run-

ning looms by means of individual motors and small group drives, and showed many slides of actual installations. A. P. Schneider, power engineer of the Lehigh Valley Light & Power Company, spoke of the savings resulting from the use of central-station energy due not only to the mental effort diverted from private plant operation and used to better advantage in actual problems of silk manufacture, but also to the increased production.

The members and guests were then conducted through the mill itself which is constructed on the one-story "daylight" plan. Looms and other machines showing the different steps in the manufacture of silk were operated and their action explained. The mill uses a total of over 500 horsepower in motors and artificial lighting is supplied by mercury-vapor lamps fed through a motor-generator set.

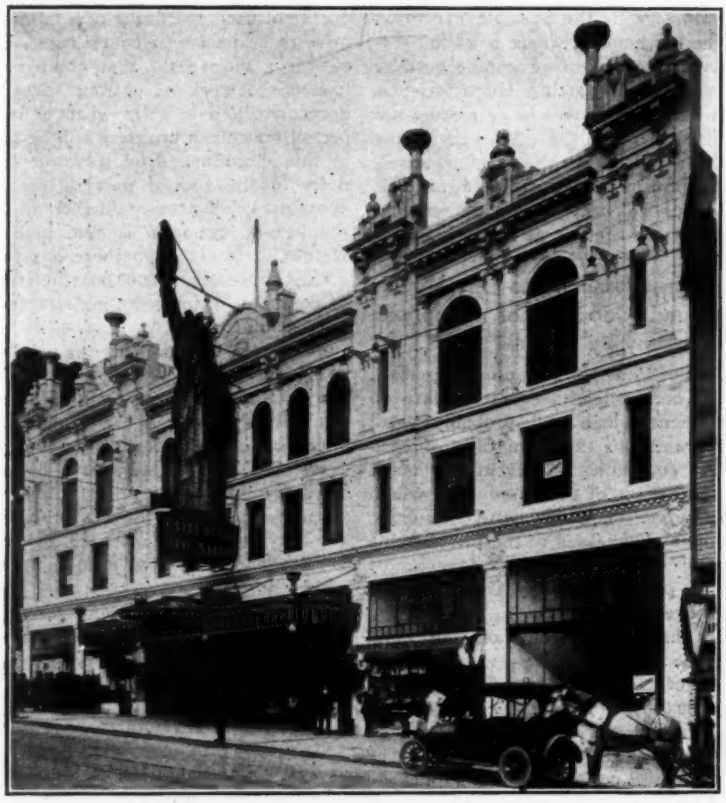
That a deep impression was made in the minds of those present was best evidenced by the numerous questions asked of the various speakers as to methods, production and costs. It was the theory of the Papers and Meetings Committee that concrete working examples of application of electric power would strike a responsive chord in those persons hardest to reach in any other way and the results of this meeting certainly justified that assumption.

Unique Lighting of Seattle Theater.

The illumination scheme of the new Liberty Theater, a motion picture house recently opened in Seattle, Wash., embodies several unique ideas and has been attracting considerable attention. The Statue of Liberty sign, shown in the accompanying illustration, stands 40 feet high, bearing aloft a flaming torch. The sign is lighted by 1,200 lamps of various colors and the flasher is operated by a one-eighth-horsepower motor.

On the top of the cornice and also on top of the marquise are four torches that apparently give forth real flame and smoke. The front of the building is brilliantly illuminated by means of eight nitrogen-filled lamps and 144 small vacuum lamps under the cornices. The marquise is a dazzling source of light and color and is lighted by 286 small lamps and four larger ones. The startling realistic effect of smoke and flame issuing from the torches on top of the marquise and cornice is obtained by having white and red lights flashed intermittently on jets of steam.

The ramp and part of the foyer are lighted by cove lighting. The main auditorium is illuminated by means of a deep cove extending around the theater and containing 150 lamps in reflectors. In the center of the ceiling is a large rosette containing a cove with 55 lamps and a huge indirect bowl with an amber shade. The proscenium arch is lighted in an ingenious and unique way. Four powerful searchlight reflectors are skillfully concealed in the rosettes on the balcony front. These light up the beautiful paintings and delicate architectural details of the arch.



Spectacular Electric Sign on Seattle Theater.

The "White Way" a Help to Central-Station Salesmen.

The installation of a "White Way" in any city is considered good business for the central station inasmuch as it means the installation of extra lamps of the standard type along the business thoroughfare or the adoption of a more or less spectacular system.

Any or all of these systems usually mean an increased revenue from street-lighting service.

There is, however, another source of revenue to the central station brought about by the installation of a "White Way" and that source is through the desire of the merchants to improve the lighting of their establishments.

Jersey City, N. J., has enjoyed a "White Way" in the downtown section for some time, the installation being of the 6.6-ampere, inverted magnetite arc lamps on ornamental standards.

Early in December, 1914, the uptown section of Newark Avenue, the main business street, was lighted in a similar manner.

The Public Service Electric Company, of Jersey City, N. J., realizing the advantage of a "White Way" as a salesman has collected the following data as the result of the second installation. All of the following improvements or additions were made prior to the turning on of the "White Way" lights and since that time many stores have put in new fronts with modern lighting and there will also be erected before the next holiday season several electric signs of the better class.

Stores in which permanent additional lighting equipment was installed..7
Windows which were altered and additional lights installed.....5
Windows in which modern lighting was installed with no additional load 3
Installations of "Front Lights" (nitrogen-filled lamps) ranging from 200 watts to 1,000 watts; all additional to existing installations..... 9

This additional business did not come without hard work. The salesman in that particular district spent nearly six months working up the merchants to the point of appreciating that a White Way is not a White Way without "White Stores."

Electric Drive for Grain Elevators.

In the application of electric motors to grain elevators, it has been found that it is best practice to combine group and individual drive. Ordinarily, induction motors are supplied for each elevator leg, while the cleaning machinery, such as separators, conveyors, dust collectors, etc., may still be driven in groups by one motor. It should be carefully noted that a brake should be provided on each motor, applied to the elevator leg, capable of preventing the leg from running backwards due to the weight of the grain, when the motor is shut off. This action will choke the elevator and cause a considerable amount of trouble. In the erection of new elevators, the adoption of electric drive frequently affects the cost of the building construction, as the supports necessary for heavy line shafting, sheaves, etc., such as are required where all the machinery is driven from one prime mover, will not be required. In many cases the savings obtained in this manner will amount to perhaps five per cent of the cost of the building.

The manner of determining the amount of power required to drive the grain elevator of such a plant involves only a simple mathematical problem. Given the weight of the grain to be elevated, the height of elevations and rate, the power required to elevate this quantity is easily calculated. To this result it is, of course, necessary to add a certain percentage to cover the friction loss caused by the doubtful rope connection, this percentage varying with the form of connection used between the motor and elevator legs and conveyor or exhaust fans.

Considering the type and characteristics of the motors required for application in feed mills and grain elevators, the direct-current motor, of the standard open type, cannot be considered because of the fire risk from sparks. The modern direct-current motor is made as sparkless in commutation as possible, but there is still danger from this point. Totally inclosing direct-current motors would make them suitable for this service, as all sparking would occur in a practically air-tight space, but this increases the size of the motors and installation considerably. Alternating current, generated by central stations, is available in most places in the country. The polyphase induction squirrel-cage motor is rugged and sparkless, and the ideal motor for these installations. Even large mills installing their own plants will find it advantageous to select motors of such characteristics that they can be operated from central-station lines in their vicinity, as an emergency service. The squirrel-cage induction motor practically eliminates fire risk, and this is of considerable importance and has direct bearing on the question of fire-insurance rates. The liability of fire is always increased by long lines of shafting, with necessary journals, bearings, accidental distortions or imperfect lubrication; flames are liable to develop due to imperfect lubrication. The amount of dust in grain elevators and flour mills has been lessened considerably by the installation of exhaust fans, but it has not been eliminated and it is still dangerous wherever there is the slightest sparking. The squirrel-cage induction motor is suitable for all applications in flour mills and grain elevators, with the possible exception of the car haulers, where a wound-secondary motor is of advantage because of the better starting characteristics, or where one of two large motors are used to drive all the machinery in the mill, in which case the wound-secondary motor is sometimes of advantage, in order to keep down the current drawn from the line at starting.

Lighting Company to Use Underground Conduits of Telephone Company by Rental.

Two of Philadelphia's most important utility companies have entered into an agreement which will probably work out greatly to the advantage of each of the companies and eventually much to the benefit of the community which they serve. The Keystone Telephone Company has leased to the Philadelphia Electric Company its unused conduits for a period of 21 years, with the privilege of renewals.

By the terms of the lease, the rental will be small at the beginning, but will increase gradually until a minimum of $100,000 per annum is reached. For the second period of 15 years, the minimum rental will be $100,000, and for the third period, the minimum rental will be $125,000 per annum. At the end of the second period the Philadelphia Electric Company has the option of purchasing conduit space in use by it at a price to be fixed by arbitration, but if for any reason the option to purchase cannot be exercised, then the privilege of renewing the lease as stated may be availed of by the Philadelphia Electric Company.

The rental will be four cents per duct-foot and as there are 12,300,000 duct-feet, there is a possible maximum rental of $480,000 per annum if the requirements of the Philadelphia Electric Company shall grow so that all available space shall be utilized by the lessee. The average minimum return on the minimum basis for the first period of 21 years to the Keystone Company will be $87,500 per annum.

The lease is so drawn that the rights of the public as to service expected from the Keystone Telephone Company will be respected as the Keystone Company may retain such space in the conduits as its own businss will require.

Negotiations were conducted by Joseph B. McCall, president of the Philadelphia Electric Company, and Edward M. Cooke, second vice-president of the Keystone Telephone Company, acting with the president, Nathan T. Folwell and the agreement has been approved by the Boards of Directors of both companies.

As the Philadelphia Electric Company will not wish to pay a rental for ducts not used, the fixing of a minimum price to be paid on an increasing scale, affords a motive for that company to hasten the work of putting wires underground and in a few years it is expected that much progress will be made in this direction. The Keystone conduits in the central part of the city contain twelve ducts. Further out, the number of conduits is ten, and still further, it is eight, so there is considerably more than 1,000,000 linear feet of conduits, which were constructed at a cost of $6,000,000.

The ordinance granting the privileges of the streets to the Keystone Company contained a provision that the company should not sell the conduits, but there is no restriction on its ability to lease such part of them as it does not need for its own purposes. A portion of the conduits in the central part of the city are already leased for news service and for wires used in burglar alarm systems.

Minneapolis General Electric Company Output Nearly Doubles in Three Years.

The extraordinary increase in the use of electricity in many American cities is well illustrated at Minneapolis, where the consumption of current for all purposes practically doubled in three years. The electrical output of the Minneapolis General Electric Company, a subsidiary of Northern States Power Company, and the Consumers Power Company of Minnesota, amounted to 110,346,460 kilowatt-hours, as compared with 57,124,396 in 1911. Since July, 1912, the property has been under the management of H. M. Byllesby & Company, and a 15,000-horsepower hydroelectric development has been constructed at Coon Rapids to supplement the two other water powers operated to serve the city. While 1913 was a year of marked growth in the business of the Minneapolis Company the record was exceeded in 1914, when 5,509 new customers and additional connected load amounting to about 16,000 horsepower were acquired.

Electrical Construction

THE INSTALLATION OF RIGID-CONDUIT WIRING IN FINISHED BUILDINGS.

By Terrell Croft.

The installation of conductors in rigid conduit provides decidedly the most expensive but the most satisfactory and safest method yet developed. A good rigid-conduit installation is impervious to water. It is very difficult, however, to wire an old building throughout with rigid conduit without a great deal of cutting and disfigurement of walls and ceilings. Hence it is seldom that a finished building is wired by this method unless it is undergoing reconstruction and plasterers and other building-trades mechanics are available to assist the wireman to cut his raceways and outlets and to repair the openings that it is usually necessary for him to make. If flexible steel conduit is used in certain locations in combination with rigid conduit an installation almost as good results, the cost is materially decreased and the building is not noticeably disfigured. For this reason, where metallic conduit is mandatory for concealed work, as it is in some municipalities (for instance, Chicago and Denver), the finished-building wiring installations usually combine rigid and flexible steel conduit.

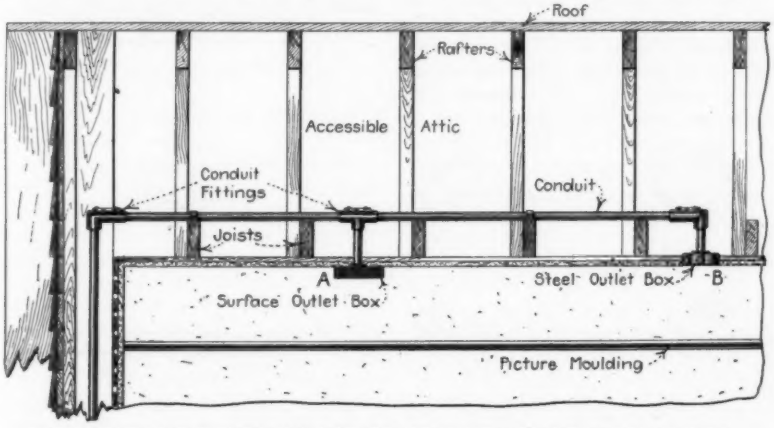


Fig. 1.—Installation of Concealed Conduit Where the Conduit Run is Available.

Properties and dimensions of rigid conduit and conduit fittings, and data covering its installation in buildings under construction may be found in existing books on this subject. The tables and other information involved are too extended for inclusion here.

In conduit installations conductors are usually looped from outlet to outlet and all outlet boxes must be available for inspection after the work has been completed. Splices can be made only in these available outlet boxes. The conductors should not be pulled in until the conduit installation is complete.

Where the conduit run is accessible, approved fittings can be used and it is not necessary to "loop" the conductors. Fig. 1 shows an example of such an installation. The attic is accessible, hence each of the fittings in it constitutes an

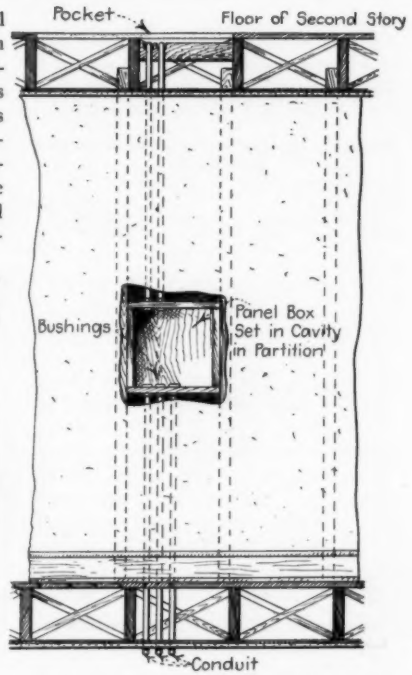


Fig. 4.—Panel Box in a Rigid-Conduit Installation.

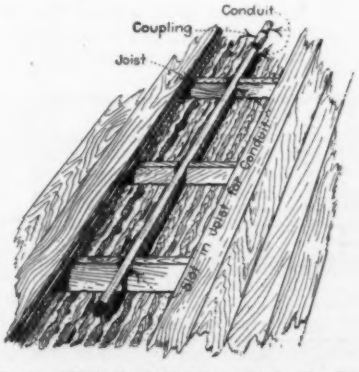


Fig. 2.—Method of Slotting Joists for Reception of Conduit.

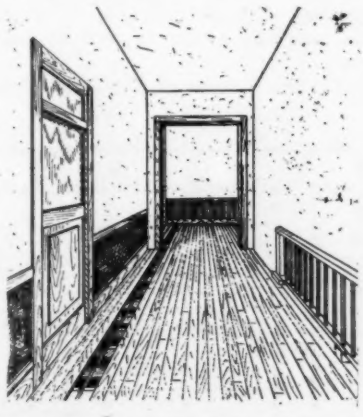


Fig. 3.—Second-Story Floor Boards Removed and Conduit in Place in Slots in Joists.

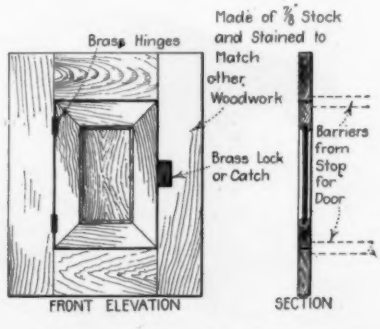

Made of 7/8 Stock and Stained to Match other Woodwork
Brass Hinges
Brass Lock or Catch
Barriers from Stop for Door
FRONT ELEVATION
SECTION

Fig. 5.—Details of Panel-Box Trim.

accessible outlet box in which wires can be spliced and tapped. The vertical conduit run shown is carried up within the space in an outside wall and the horizontal run is clamped to the joists with pipe straps. Surface outlet boxes like that at A can be used where it is undesirable to cut a large hole in the ceiling, but the usual practice is to use pressed-steel boxes, with their lower edges set flush with the surface of the ceiling as at B.

Figs. 2 and 3 show how the floor joists of a frame building should be slotted for the reception of a conduit run. After the conduit is in place and held there with a few nails driven into the joists and bent over the conduit, the floor boards may be replaced. The slots should be as narrow and shallow as will comfortably admit the conduit. Those in the illustration are exaggerated in size so that they will show plainly. Each slot is fashioned by making two vertical saw-cuts in the joist and then gouging out the little block between the cuts with a wood chisel.

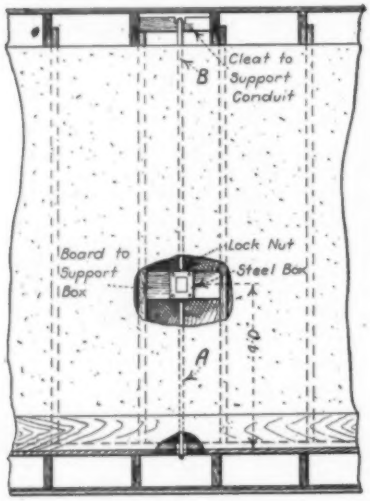


Fig. 6.—Rigid-Conduit Switch Box in Position.

The general procedure in installing rigid conduit in finished buildings is about as follows: (1) Determine the location of the (*a*) entrance, (*b*) meter and (*c*) panel box or distribution center; (2) install the feeder conduit to the panel box; (3) install the vertical runs within walls and partitions to bracket and switch outlets and the like; (4) connect the vertical runs with horizontal runs and (5) pull in the wire and connect it.

The conduit for the feeder between the point of entrance and the panel box is usually installed on the cellar ceiling and is held thereto with pipe straps. The entrance switch and meter are most frequently located in the cellar. The panel box is usually in the first or second-floor hall. A hole is bored from the cellar up through the floor plate or sill of the partition in which the panel box is to be located. An elbow is bent in one end of a length of conduit, of the diameter to be used for the feeder, and the conduit is pushed through the hole until one leg of the elbow rests against the cellar ceiling. It is cleated to the ceiling and the run is continued to the entrance. The panel box is later set down over the end of the piece that was pushed through the floor.

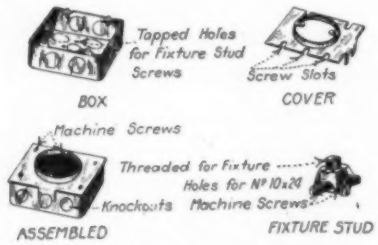


Fig. 8.—Bracket Box and Fixture Stud.

A box, without its trim, in position with the conduit lines run into it, is shown in Fig. 4. The lath and plaster must be cut away as illustrated to provide for the admission of the box. At the sides the lath and plaster should be cut off flush with the faces of the studs. Vertically, the hole must be longer than the box to give a space in which the lock-nuts can be run on the conduit. The trim of the panel-box (Fig. 5) should be made wide enough to cover the openings so left.

The box is made of such a width that it will just fit between the studs. Its overall depth should be about equal to the depth of the studs plus the thickness of the plaster, so that the front edges of the box will lie flush with the surface of the plaster when the box is fastened in place. The plaster on the opposite side of the partition may extend through its lath a half inch or so. This should be considered in making the box.

Before the box is placed, the holes for the conduits that are to enter it should be bored through the ceiling and floor plates and through the bridges if there are any. The holes in the box for the conduit should be so spaced that the conduits will enter readily. The box being in position, the conduits are let down from above and pushed up from below and a lock-nut is run on each. Then they are pushed through the holes in the box and a bushing is turned on each one inside of the box. Frequently it is a good plan to place the conduits that are to enter the box from the bottom before the box itself is set in position. Then the box, the holes having been bored in its bottom, is set down over the conduits. Then the conduits that are to enter the box from above are placed.

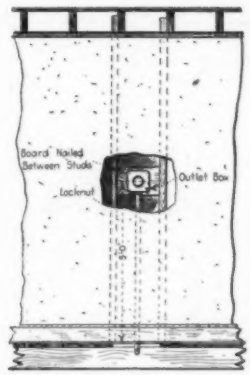


Fig. 9.—Conduit Run to a Bracket Outlet.

Fig. 6 shows the installation of a rigid-conduit switch box which serves, through B, an electrolier hung from the ceiling. It feeds, through A, from a conduit run located within the floor. This run comes from a panel box like that of Fig. 4. To place a rigid-conduit

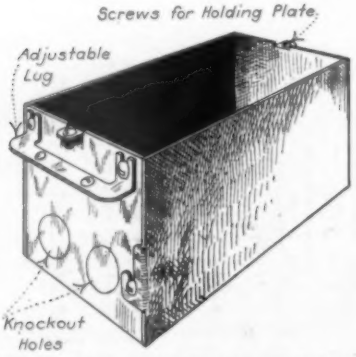


Fig. 7.—Steel Outlet Box for Switch or Plug Receptacle.

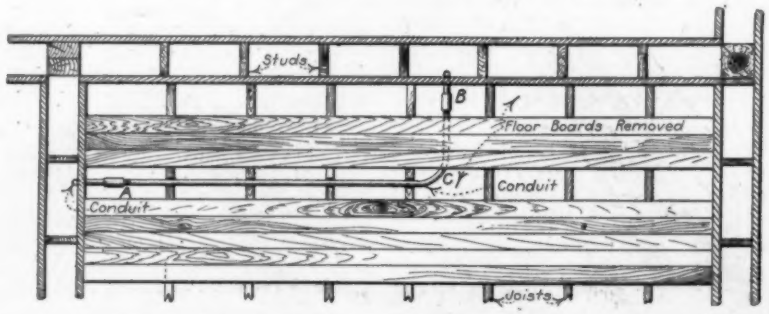


Fig. 10.—Method of Installing Rigid Conduit Within a Floor.

switch box it is usually necessary to cut a hole, extending from stud to stud, in the lath and plaster of the partition; to remove the baseboard and to cut a pocket in the floor at the foot of the partition. If no conduit enters the switch box from below, the removal of the baseboard and the cutting of the pocket are unnecessary. It is almost impossible to fasten a switch box to rigid conduit with the necessary lock-nuts and bushings without cutting a reasonably large hole in the partition surface in which to work, even if a switch box of the compact type of Fig. 7 is employed.

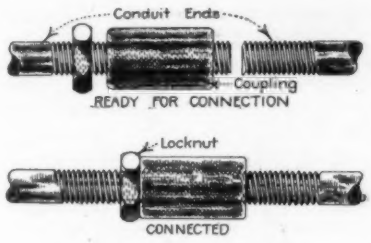


Fig. 11.—Running Thread.

A slot is cut in the floor plate—and in the floor, if it extends under the floor plate—it being assumed that the baseboard has been removed. A conduit elbow is placed in the slot with one arm "looking" toward the switch box and the other extending out parallel to the joists. Then a length of conduit, just long enough to reach the switch box, is screwed to the arm of the elbow within the partition. The switch box is clamped to it with lock-nut and bushing and is then fastened with wood screws to the board that has been nailed in between the studs for its reception. The board should be located far enough back from the face of the partition that when the box is set its outer edge will be flush with the partition surface. The conduit run upward from the switch box can be continued by dropping a conduit length down to the box from above and fastening it thereto with a locknut and a bushing.

Fig. 8 shows the type of steel outlet box that is used; however, a "switch outlet" cover is employed instead of the round cover shown, which is designed for bracket and electrolier outlets.

In installing a bracket outlet box (Fig. 9) it is set in essentially the same manner as the switch box. However, the opening in the cover is round instead of rectangular. Fig. 8 shows the box assembled and disassembled. The fixture stud, held to the back of the box with four No. 10 x 24 machine screws, is for supporting the fixture.

The method of joining rigid vertical conduits by a horizontal connection within a floor is illustrated by Fig. 10. It is desired to connect B, which is from a switch outlet, to A, which is from a bracket outlet. Both terminate just below the floor. Remove the floor boards and slot the joists as shown. Measure the distance from B to C where the connecting conduit must turn toward A. Bend a piece of conduit of the required length to an L shape so that it will just fit in between conduit ends A and B. At each end of the connecting conduit, cut a running thread, Fig. 11. Hold the connecting conduit thus prepared, with its ends butted against conduits A and B while the couplings are screwed on the ends of these two pieces of duct.

In halls or high-ceilinged rooms where the use of staging built up from the floor is expensive or otherwise undesirable, fixtures may be supported as shown in Fig. 12. First determine the location of the ceiling outlets by careful measurements and cut a one-inch hole in the ceiling at each outlet, drilling downward from above. Directly above the outlet nail a piece of 2-by-4-inch timber between the joists and through it bore a one-inch hole in the same vertical line with the hole in the ceiling. Then fasten a four-inch outlet box on the timber with wood screws. Into the outlet box run the conduit, which can be carried in a groove in the tops of the joists.

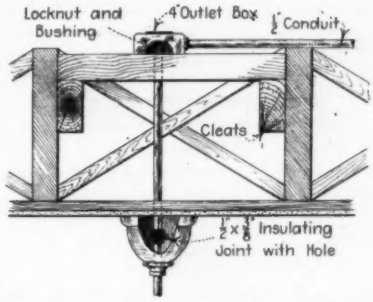


Fig. 12.—Supporting Fixture From an Attic.

A piece of half-inch conduit is then cut the proper length to reach from the outlet box to the ceiling. Both ends of this pipe having been threaded, it is screwed to the fixture by means of a 0.5-by-⅜-inch insulating joint used for combination fixtures. Then assemble the fixture completely on the floor, running the fixture wires up through the insulating joint and the piece of conduit. Pull the fixture up. A half-inch lock-nut and bushing screwed onto the pipe will complete the job and hold the fixture in place.

In a building having an elevator shaft

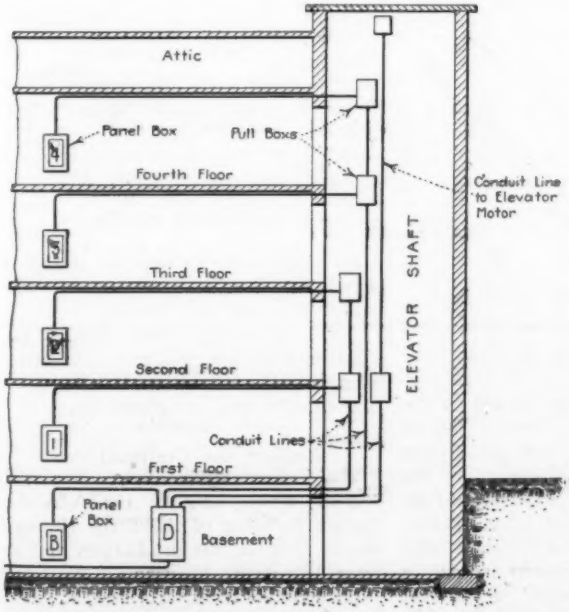


Fig. 13.—Conduit Lines Installed in an Elevator Shaft.

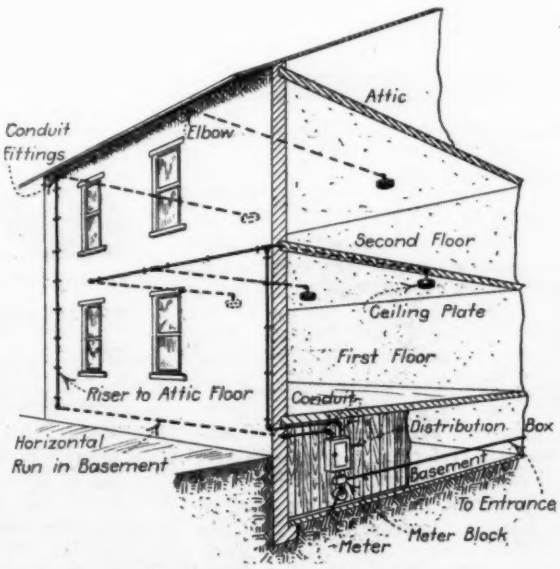


Fig. 14.—Supporting Conduit on Building Exterior.

and no other vertical way in which the conductors can be carried, they can often be installed in it, provided they are in conduit, as shown in Fig. 13. Conduit wiring is the only method that is approved by the Code for elevator shafts. A good conductor layout is shown. A panel box having a branch-circuit capacity sufficient for that floor, is located on each floor and an individual main is carried from a distribution cabinet in the basement to each of the boxes. A separate conduit line is carried to the elevator motor.

In a building of several stories a conduit riser can often be employed advantageously as suggested in Fig. 15. The illustration shows the wiring of an apartment building wherein the service to the apartment on each floor is tapped from the vertical riser, which is carried in conduit, through a tier of closets. The closets being located on each floor, one directly over the other, provides for the concealment of the conduit run and for its relatively easy installation. Sometimes it is preferable to install the vertical conduit riser on the exterior of ar old apartment building rather than on the interior. Usually a central station will place a riser to feed several apartments at its own expense, so the owner merely has to pay for the wiring in the apartments themselves.

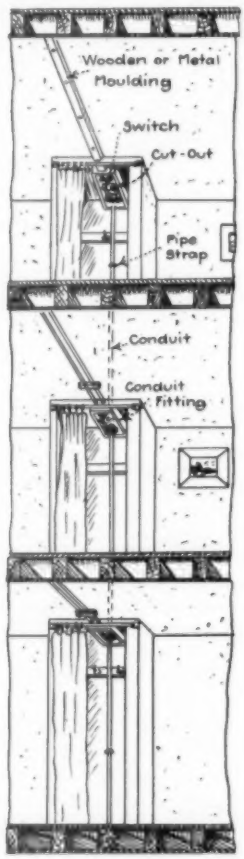


Fig. 15.—Vertical Conduit Run to Serve Different Floors.

Exposed conduit for finished building wiring is sometimes employed as suggested in Fig. 16. Such an installation is relatively expensive but is sometimes necessary where concealed work is not feasible, where molding work will not be accepted and where open wiring on knobs and cleats cannot be put in, either because of the unsightliness or because it may be interfered with.

The method (Fig. 14) of installing rigid conduit on building exteriors is sometimes utilized where it is desirable to make a conduit installation at minimum cost or where because of double floors or obstructions within walls or partitions it is impossible to route the conductors in any other manner. Probably piping installations, made in finished buildings for illuminating gas, suggested this device for handling conductors, because one notices, particularly in the older towns of the Middle West, many old buildings served with gas with the principal runs of piping secured to the outside of the house with straps. Where zinc-coated conduit that will "take" paint effectively is used, and where the exposed exterior conduit runs are carefully concealed in corners and behind spouts, the conduit, when painted the same color as the surface that supports it, will be inconspicuous. The method can be used very effectively in many cases where the cost of wiring by any other would be prohibitive.

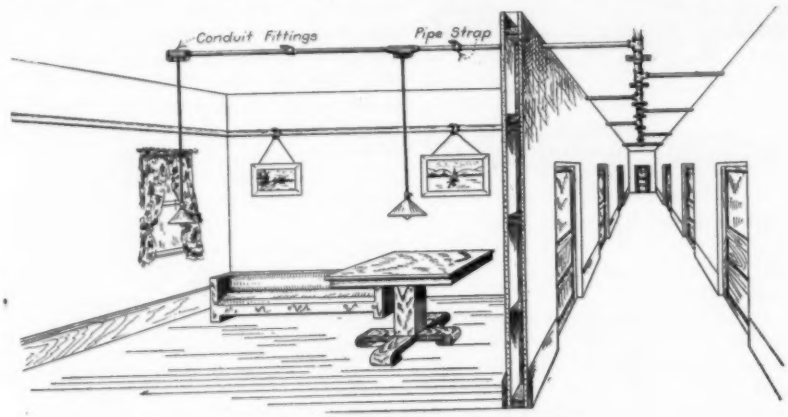


Fig. 16.—An Exposed Conduit Installation.

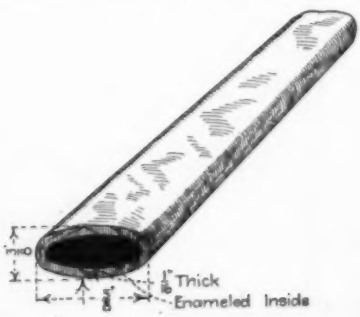


Fig. 17.—Section of Ovalduct.

Ovalduct (Fig. 17), made by the National Metal Molding Company, is seamless drawn-steel tube, sherardized inside and out and then enameled on the interior. It can be readily bent flat side or endwise to conform to the surface on which it is to be mounted. The dimensions are given in the figure. It is used principally in making additions to existing conduit wiring in fireproof buildings. Where extensions are made with conduit in these buildings, it is frequently necessary to channel deep raceways for the reception of the conduit. Floor arches may be destroyed and their strength seriously impaired. With the ovalduct, extensive channeling is unnecessary. It can be laid in a shallow groove in the plaster and fastened to the fireproofing in the ceilings with short tie wires which are fished through two small holes in the tile. After installation it is plastered over so as to be entirely concealed. Ovalduct will accommodate two double-braid No. 14 wires or one No. 14 duplex wire. Two No. 14 wires pull in more readily than does one duplex.

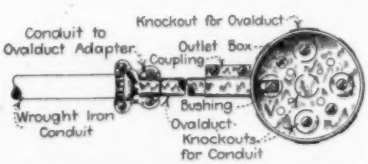


Fig. 18.—Ovalduct and Fittings.

Outlet boxes and other fittings are manufactured for ovalduct. Adapters, whereby it can be joined to wrought-iron conduit runs, are obtainable.

Among the Contractors.

The electrical contract for the Nurses' Home and for the Administration Building of the State Homeopathic Hospital for the Insane, at Rittersville, near Allentown, Pa., has been awarded to R. W. Keck & Company, of Allentown.

Public Service Commissions

Conducted by William J. Norton

NEW YORK—Second District.

Great Bear Light and Power Company. In deciding the complaint brought by Brenton M. Ryder against the Great Bear Light and Power Company, the Commission held that an electric corporation may not arbitrarily cut off the current of a consumer, without evidence that the consumer's wiring is unsafe, and merely because the consumer refuses to furnish a certificate from a particularly designated unofficial organization such as the Underwriters' Association, as evidence that the consumer's electric installation is safe.

The electric company had been supplying the complainant with current for a number of years when it sent a circular letter informing its patrons that "the High Courts have recently handed down decisions against some of the large electric light companies who had furnished current to consumers without Underwriters Inspection Permits, holding them responsible for fires which had been traced to electric wires from improper installations."

The letter requested customers to secure these permits from the secretary of the Underwriters in Schenectady. The complainant refused to do this, but did not, however, refuse to let the company's representative inspect his wiring.

The Commission ordered the company to restore the service to complainant, and by so doing refuses to permit the company to place the burden of proof of the safety of installation upon the customer, where the installation has proven safe through actual usage. The Commission says that it is doubtless the right and probably the duty of an electric corporation, in the interest of public safety to satisfy itself that a private electric installation is safe before it supplies current thereto and to impose regulations for its continued safety.

VIRGINIA.

The Virginia Railway and Power Company. The hearing on the company's rates before the State Corporation Commission has been closed by the withdrawal of the petition of the City of Richmond. These rates filed with the Commission to become effective April 1, 1915, were noted in ELECTRICAL REVIEW AND WESTERN ELECTRICIAN, January 23, 1915 (p. 156). A close examination of the rates convinced the attorneys for the city that there was no reason for objecting to the company's revision of its schedule. The new rates provide a substantial reduction in the rates of all consumers coming under the classification of retail light and power.

WASHINGTON.

The Bremerton-Charleston Light and Fuel Company has been authorized to establish a prompt-payment discount of ten per cent and a rate for cooking. The cooking rate is three cents per kilowatt-hour with a minimum charge of $2.00 per month per range connected.

WISCONSIN.

The Ebenezer Telephone Company alleges that the Milwaukee Light, Heat and Traction Company has constructed its high-tension electric lines parallel to its telephone lines to the detriment of its telephone service. Before the respondent erected its poles on the same side of the highway on which petitioner's lines are located the petitioner requested it not to do so, but to place them on the opposite side of the highway. The respondent, however, constructed its lines as planned and petitioner claims that as a result its telephone lines have been short-circuited.

The Commission says that the high-tension electric lines and the telephone line should be located on opposite sides of the highway, but finds that it is without jurisdiction to order either company to re-locate its line. The decision reads as follows: "The confronting difficulty in the case is the want of jurisdiction in the Commission to compel either company to change the location of its lines. If the telephone company has suffered damage because of the interference with its service and business, it may possibly recover the same in an action in court. It is the duty of the telephone company under the circumstances to render its service adequate at its own expense, if the respondent is unwilling to bear the same. If it has any remedy against the respondent it must seek the same in court. The situation here presented suggests the necessity of additional legislation, giving the Commission power to determine the location of high-voltage transmission lines. Numerous cases are arising due to the interference of high-voltage transmission lines with telephone lines. If, before the construction of a high-tension line, it was incumbent upon the corporation constructing such lines to apply to the Commission for authority as to route and location, the difficulty presented is the instant case and other cases pending before the Commission, would be obviated in the future. For the reasons stated, the petition must be dismissed."

A similar petition was entered by the Platteville Rewey & Ellenboro Telephone Company and the Farmers' Telephone Company against the Lancaster Electric Light Company. This petition was also dismissed for lack of jurisdiction.

Telephone Regulation in Minnesota.

It seems practically certain that state control of telephone rates and service in Minnesota will be one of the results of the present legislative session in St. Paul. The Minnette bill, which was passed by both houses of the legislature two years ago and defeated by the governor's veto, is again up for consideration. It was recommended for passage February 19 by the House Committee on Telephone and Telegraph Service and will be disposed of without further delay.

The main feature of the bill, (state control of telephone rates and service) is meeting no opposition. The companies are practically unanimous in welcoming uniform control by the state as a substitute for independent regulation by every city and village. One of the points in controversy is whether the state should allow the construction of parallel lines and competing exchanges. One view is that the telephone business is a natural monopoly and should be kept so as far as possible under state regulation. Opponents of this view argue that better service can be obtained by permitting competition and the disagreeable features can be overcome by compelling physical connection of the competing lines.

Electrical Engineering Problems.

By R. G. Hudson and W. V. Lyon.

DIRECT CURRENTS.

Problem 25.

A 230-volt 20-kilowatt 1,200-revolutions-per-minute belt-driven shunt generator is operated in parallel with other generators, the voltage of the system being maintained constant at 230 volts. The armature resistance between brushes is 0.12 ohm. When running at 1,200 revolutions per minute with no armature current and connected electrically to the system the mechanical input to the generator is 1,320 watts.

If the belt should slip off the pulley under these conditions find (*a*) the speed of the armature and its direction of rotation, (*b*) the magnitude and direction of the armature current, (*c*) the electrical power input to the armature and (*d*) the stray power, assuming that the stray power is proportional to the armature voltage.

SOLUTION OF PROBLEM 25.

Any dynamo armature running under load is acted upon by three torques, as follows: (1) the shaft torque (a torque applied externally to the shaft), (2) the current-flux torque (due to the reaction between the armature current and the field flux) and (3) the stray power torque (due to friction, windage, hysteresis and eddy currents). For constant speed of rotation these three torques must be in equilibrium.

When the armature turns in the direction in which the shaft torque acts the dynamo is called a generator and when it turns in the direction in which the current-flux torque acts the dynamo is called a motor. In either case the stray power torque opposes the rotation of the armature. In generator action the shaft torque opposes and equals the sum of current-flux torque and the stray power torque. In motor action the current-flux torque opposes and equals the sum of the shaft torque and the stray power torque.

The direction in which the current-flux torque acts depends upon the relative directions of the armature current and the field flux as outlined in the Solution of Problem 24. By combining the principles stated in the answers to Question *b*, Problems 11 and 24, it will be found that when current flows in any conductor in the same direction as the generated emf. acts in that conductor, the current-flux reaction opposes the motion of the conductor. Conversely when the current flows in the opposite direction to that in which the generated emf. acts, the current-flux reaction aids the motion of the conductor.

Since the armature voltage in any practical case acts within the armature toward the positive brush, a flow of current externally from the positive brush indicates opposition to rotation by the current-flux torque and a flow of current externally to the positive brush indicates assistance to rotation by the current-flux torque. Motor or generator action may then be determined from the relative directions of the armature current and the armature voltage; conjunction indicating generator action and opposition motor action.

When the armature voltage acts in opposition to and exceeds the terminal voltage the armature current will flow in conjunction with the armature voltage, and when the armature voltage acts in opposition to and is less than the terminal voltage the armature current will flow in opposition to the armature voltage. The armature current in either case is given by [6] and equals the difference between the armature voltage and the terminal voltage divided by the armature resistance between brushes.

Answer to Question a.

When running at 1,200 revolutions per minute with no armature current the power input (1,320 watts) is taken up solely by the stray power. Since the terminal voltage is 230 volts and the armature current is zero, the armature voltage must also equal 230 volts. The shunt field is connected to the 230-volt system and the shunt-field current is therefore constant and independent of the conditions existing within the armature. The armature voltage is then directly proportional to the speed (field flux is constant) and since the stray power varies with the speed it must vary in the same manner with the armature voltage. Although the stray power will not vary directly with the speed or armature voltage as assumed (see Problem 22) such an assumption is sufficiently accurate in view of the slight speed changes involved. The stray power (SP) at any armature voltage (E_a) is then given by

$$SP=1{,}320E_a/230=5.74E_a \text{ watts.}$$

After the belt slips off the pulley the shaft torque, which previously caused the armature to rotate, becomes zero and the armature speed decreases. A decrease of armature speed, however, is followed by a decrease in armature voltage. The terminal voltage being fixed at 230 volts, current will flow into the armature at the positive brush. The magnitude of this current for any value of armature voltage is given by [6]

$$I_a=(230-E_a)/0.12 \text{ amperes.}$$

Since this current flows in opposition to the armature voltage it aids in rotating the armature. When the driving belt slips off the pulley, motor action takes the place of generator action, the direction of rotation and armature voltage remaining unchanged. The armature will drop in speed until the current as obtained by [6] multiplied by the terminal voltage, or the electrical power input to the armature (P_1), equals the heating loss (P_h) in the armature winding plus the stray power (SP). The armature heating loss given by [20] is

$$P_h=(230-E_a)^2\times 0.12/(0.12)^2$$
$$\text{or}=(230-E_a)^2/0.12.$$

Substituting in the equation, $P_1=P_h+SP$, we have

$$230(230-E_a)/0.12=(230-E_a)^2/0.12+5.74E_a.$$

Solving, E_a equals 229.331 volts, the large number of figures retained being necessary for checking the results. Since the armature speed (S) is proportional to the armature voltage we have

$$S=1{,}200\times 229.311/230=1{,}197 \text{ revolutions per minute.}$$

The direction of rotation is the same as that before the belt slipped off.

Answer to Question b.

The armature curent (I_a) is given by [6]

$$I_a=(230-229.311)/0.12=5.74 \text{ amperes.}$$

The current flows into the armature at the positive brush.

Answer to Question c.

The electrical power input (P_1) is given by [19]

$$P_1=230\times 5.74=1{,}320.2 \text{ watts.}$$

Excess figures are retained in the result as before for the purpose of checking.

Answer to Question d.

The stray power equals $5.74E_a$, or $5.74\times 229.311=1{,}316.2$ watts. This result may be checked by the equation, $P_1=P_h+SP$, or [43]

$$SP=P_1-P_h \text{ watts.}$$

Substituting in [43],

$$SP=1{,}320.2-(5.74)^2\times 0.12$$
$$=1{,}320.2-4.0$$
$$=1{,}316.2 \text{ watts.}$$

It should be observed that the stray power of a dynamo for any speed and

ALTERNATING CURRENTS.

Problem 75.

The following test data are given on a 1,500-horsepower, 13,200-volt, three-phase synchronous motor:

Field Current	Open-Circuit Terminal Voltage	Terminal Voltage I_a=49, $P.F.$=0	Open-Circuit Core Loss
50	8420	.....	8.4
80	12400	.....	18.6
110	14900	10300	28.4
140	16500	12700	37.5
180	18100	14900	....

The armature windings are connected in star and have a hot resistance of 2.52 ohms measured by direct current between terminals. The ratio of effective to direct-current resistance is 1.55 The resistance of the field circuit is 0.61 ohm. The friction and windage loss is 9.32 kilowatts.

This motor is operating on a 13,200-volt circuit and delivers a constant load of 1,250 horsepower. (*a*) The excitation is adjusted so that the motor takes a line current of 50 amperes at a lagging power-factor. At what power-factor does it operate? What is the necessary field current? What is the efficiency of the motor? (*b*) To what value should the field current be increased so that the motor will take the same current at a leading power-factor? What would be the efficiency in this case? (*c*) What is the least value that the armature current can have? What would be the necessary excitation voltage? Compare the armature resistance loss with that under (*a*) and (*b*).

armature voltage may be determined from [43] by operating the dynamo as a motor at the required speed and armature voltage. The power input may be measured in this manner with greater accuracy than by the method proposed in Problem 22.

SOLUTION TO PROBLEM 75.

Answer to Question a.

We have seen that a synchronous generator in parallel with others can deliver either a lagging or a leading current, depending upon its excitation. Similarly a synchronous motor will take either a lagging or a leading current from the circuit, depending upon its excitation. Normal excitation is that with which the motor operates at unit power-factor. If the excitation is less than normal the current is lagging, but if it is greater than normal the current is leading. This is exactly contrary to condition in a generator that is operating in parallel with others.

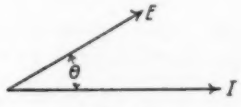


Fig. 32a.

In a synchronous machine, as well as in a direct-current machine, the only difference between motor and generator action is that the currents are *reversed* with respect to the generated voltage. In a generator the current is in the same direction through the armature as the electromotive force, while in a motor they are opposed to one another. Fig. 32a is for a synchronous generator, while Fig. 33a is for a synchronous motor with the same phase angle between the current and generated electromotive force.

A synchronous motor will develop no net torque except when running at synchronous speed. This is defined in formula

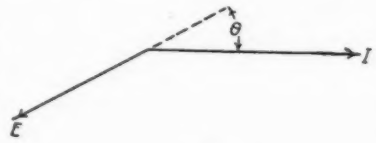


Fig. 33a.

[41a] $N=120f/P$

where N is the speed in revolutions per minute, f is the frequency of the circuit and P is the number of poles on the motor. If the average speed is other than synchronous, the motor will develop no net torque, and will come to rest. This statement is true only for the torque developed by synchronous motor action. In any actual motor there may also be torque developed by hysteresis and by the induction motor action of the eddy currents produced in the pole faces and in the damping winding, if one is used. This torque is only present when the motor is not running at a *uniform* synchronous speed. Due to its action, a polyphase synchronous motor is self-starting. The starting torque due to synchronous motor action is zero. These motors are not adapted to a load which requires a large starting torque.

As in the case of the generator we first calculate the effective resistance and the synchronous reactance of the armature per phase. The resistance per phase is one-half of that between terminals in the case of a star-connected armature winding.

The true resistance per phase is

$$2.52/2=1.26 \text{ ohms.}$$

The effective resistance of the armature per phase is

$$r=1.55\times1.26$$
$$=1.95 \text{ ohms.}$$

The field current necessary to produce

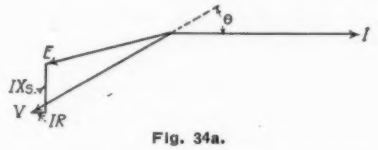


Fig. 34a.

a terminal voltage of 13,200 volts when the armature delivers 49 amperes at zero power-factor is

$$I_f=140+[(13,200-12,700)/(14,900-12,700)]\times(180-140)$$
$$=149 \text{ amperes.}$$

On open circuit this field current will produce a terminal voltage of

$$E=16,500+[(149-140)/(180-140)]\times(18,100-16,500)$$
$$=16,900 \text{ volts.}$$

By the American Institute of Electrical Engineers' method for computing the synchronous reactance per phase

$$X_s=(16,900-13,200)/(\sqrt{3}\times49)$$
$$=43.6 \text{ ohms.}$$

The vector diagram is given in Fig. 34a. It is first necessary to find the power-factor at which the motor operates.

By [2a] $P.F.=P/VI$

where P is the power input per phase, and V and I are the applied voltage and current per phase. The power input is equal to the output plus the losses. At this point we will assume that the exciter which supplies the field current is not driven by the synchronous motor itself. If it were the power required to drive it would have to be included in the losses. The losses in this case then are the friction and windage, the core loss and the armature-resistance loss. The core loss may be taken as equal to that on open circuit with a terminal voltage of 13,200. This is only approximately true. A small error in its value is of not much account.

The core loss equals

$$P_c=18.6+[(13,200-12,400)/(14,900-12,400)]\times(28.4-18.6)$$
$$=21.7 \text{ kilowatts.}$$

The armature-resistance loss is

$$3I^2R=3\times50^2\times1.95$$
$$=14.6 \text{ kilowatts.}$$

The power input per phase is

$$P=(1,250\times0.746+9.32+21.7+14.6)/3$$
$$=326 \text{ kilowatts.}$$

The terminal voltage per phase is

$$13{,}200/\sqrt{3}=7{,}620$$

By [2a] $P.F.=326{,}000/7{,}620\times 50$
$=0.856.$

The horizontal and vertical components of the terminal voltage are

$$V_h=7{,}620\times 0.856$$
$$=6{,}620$$
$$V_v=7{,}620\times\sqrt{1-0.856^2}$$
$$=3{,}950.$$

If we take as the positive direction of the horizontal components to the right and as the positive direction of the vertical components upward, both of these components will be negative in this case.

By [19a] $E_h=-6{,}620+50\times 1.95$
$=-6{,}523$
$E_v=-3{,}950+50\times 43.6$
$=-1{,}770$

By [20a] $E=6{,}760$ volts.

The corresponding line voltage is

$$6{,}760\times\sqrt{3}=11{,}700.$$

From the plot of field current and open-circuit terminal voltage the necessary field current is found to be 75 amperes. This is under normal excitation.

In computing the efficiency it is necessary to include the loss in the field circuit. In this case it is

$$(I^2R)_f=75^2\times 0.61$$
$$=3.43 \text{ kilowatts.}$$

The total input including the field loss is

$$P_i=932+9.32+21.7+14.6+3.43$$
$$=981.$$

The efficiency is

$$\eta=932/981$$
$$=95.0 \text{ per cent.}$$

Answer to Question b.

The vector diagram is given in Fig. 35a. The power-factor is unchanged in magnitude, but the current is now leading the

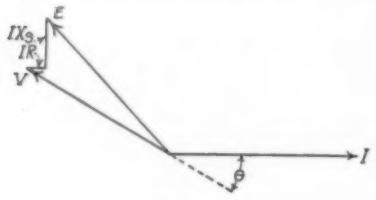


Fig. 35a.

impressed voltage. The vertical component of V is now positive.

By [19a] $E_h=-6{,}620+50\times 1.95$
$=-6{,}523$

This is the same as before.

$$E_v=3{,}950+50\times 43.6$$
$$=6{,}130.$$

By [20a] $E=8{,}950$.

The corresponding line voltage is

$$8{,}950\times\sqrt{3}=15{,}500.$$

From the open-circuit characteristic the field current is

$$I_f=121 \text{ amperes.}$$

The field loss is

$$121^2\times 0.61=8.94.$$

The input is

$$P_i=932+9.32+21.7+14.6+8.94$$
$$=987.$$

The efficiency is

$$\eta=932/987$$
$$=94.4 \text{ per cent.}$$

Answer to Question c.

The least current that the motor can take and still deliver the required load is when it is operating at unit power-factor.

The input is

$$P_i=932+9.32+21.7+3I^2R/1{,}000$$
$$=963+3I^2R/1{,}000$$
$$=963+0.00585I^2.$$

The input is also equal to

By [1a] $P_i=3\times 7{,}620\times I$
$=22.86I$ kilowatts.

Equating these two values for the input gives

$$22{,}860I=963{,}000+5.85I^2.$$

This can be solved as a quadratic equation, but it is fully as accurate if it be

DIRECT CURRENTS.

Problem 26.

A 25-horsepower 230-volt shunt motor is to be accelerated under full-load torque with a starting-box and switch as shown in Fig. 23. During acceleration the armature current must not exceed 150 amperes and when the armature current drops to the full-load value, 90 amperes, successive sections of the resistance in the starting-box are short-circuited.

If the armature resistance is 0.12 ohm, find (*a*) the proper resistances of the respective sections, AB, BC, CD, DE, and EF.

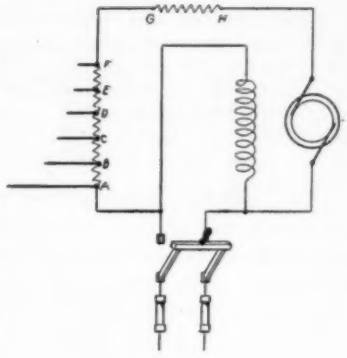


Fig. 23.

This problem illustrates the requirements for starting a direct-current shunt motor.

ALTERNATING CURRENTS.

Problem 76.

The armature windings of a 5,000-horsepower, 6,600-volt, three-phase synchronous motor are connected in delta. The resistance measured between terminals at the running temperature is 0.154 ohm. The ratio of effective to true resistance is 1.5. The synchronous reactance is 5.2 ohms per phase. The friction and windage is 30 kilowatts, and the core loss, which may be assumed to be constant, is 69 kilowatts. The field current is obtained from a separately driven exciter.

(*a*) What is the full-load line current? (*b*) What are the input and power-factor at no-load if the field current is adjusted so that the armature current has its full-load value? (*c*) What is the necessary excitation voltage, both for under- and over-excitation, in question (*b*)? (*d*) If this motor delivers a load of 4,000 horsepower, over what range can the power-factor be varied without exceeding the full-load armature current, and what would be the greatest and least necessary values of the excitation voltage? (*e*) If this motor is operating alone at the end of a transmission line, which has a resistance of 0.98 ohm and a reactance of 0.86 ohm per conductor, what is the line voltage at the motor when it delivers 1,000 horsepower and the excitation is adjusted so that it takes full-load current at a leading power-factor? The voltage at the power station is 6,600 volts.

This problem illustrates the operation of a synchronous motor.

Solutions of the above problems and two new problems will be printed in the next issue.

done as follows. Neglect the $5.85I^2$ and obtain an approximate value of I as 963,000/22,860=42.1 amperes. Substitute this value of I in the term $5.85I^2$ and solve again for I

$$I=(963{,}000+5.85\times 42.1^2)/22{,}860$$
$$=42.6 \text{ amperes.}$$

This method of solving a quadratic equation gives a good result only when the square term is small, as it is in this case.

The armature-resistance loss will be

$$(42.6/50)^2=72.5 \text{ per cent}$$

of its value in (a) and (b).

The vector diagram is given in Fig. 36a.

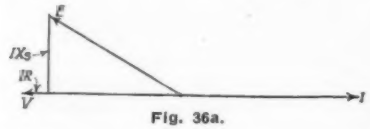


Fig. 36a.

By [19a] $E_h=-7{,}620+42.6\times 1.95$
$=-7{,}537$
$E_v=0+42.6\times 43.6$
$=1{,}860.$

By [20a] $E=7{,}770$ volts.

The corresponding field current would be for $7{,}770\times\sqrt{3}$ volts and is 93 amperes. This is the normal excitation for this load.

Society for Electrical Development Directors' Meeting — National Electrical Week Discussed.

At a meeting of the Board of Directors of the Society for Electrical Development, held at the Society's offices in New York, Wednesday, February 17, the matter of employing a resident representative on the Pacific Coast was discussed and referred to the president and general manager.

James Smieton, Jr., who has been acting as secretary-treasurer for the past year was appointed secretary-treasurer of the Society.

The principal matter under discussion was the plan for a national electrical week. The Board unanimously approved the plans of the committee, which were reported in the ELECTRICAL REVIEW AND WESTERN ELECTRICIAN January 23, and it was decided to go ahead with the plans for an electrical week, the date for which was not definitely decided upon, the majority of those present, however, being in favor of holding it early in the spring of 1916, as it was felt that this would give the manufacturers of all kinds of electrical devices a better opportunity to reap a substantial benefit, and it was recognized that a year's hard, earnest work will be required to perfect and carry out the plans necessary for so important an event.

The general manager's and treasurer's reports showed the Society to be in a very satisfactory condition.

Questions and Answers.

All readers of the Electrical Review and Western Electrician are invited to submit questions and answers to this department. Full names will not be printed except where the writer indicates his willingness therefor. Anonymous communications will not be considered. Questions relating to electrical matters of any kind will be inserted. Answers from our readers should be received in this office preferably within ten days of the date of publication of the question, and will be published in a subsequent issue. Payment will be made for all answers published.

Questions.

No. 262.—ELECTRICALLY DRIVEN STREET SWEEPER.—Has any electrically driven suction street sweeper ever been tried out by any municipality or street-car company?—F. N. S., Toronto, Canada.

No. 263.—REWINDING MOTOR.—I have a series motor running at 1,100 revolutions per minute that I want to have run at 1,700 revolutions. I would like to know whether to rewind the armature alone or to rewind both the armature and fields. At first I intended to rewind only the armature and connect the fields in multiple, which it seemed to me would answer the same purpose as rewinding the fields; then I thought I would find out what other readers suggest.—J. B., New York.

No. 266.—LIGHTING SHALLOW WINDOW.—Is there any way of lighting uniformly the rear display surface of a show window only 14 inches deep, 4 feet wide and 6 feet 6 inches high?—M. P., South Bend, Ind.

No. 267.—VOLTAGE REGULATOR.—Does any one know of a device which can be used on a 550-volt, three-phase circuit to regulate the voltage of same independent of the generator? It is a case where three generators are used at different times to supply a line and the ordinary regulator as applied to each machine would be too expensive.—A. S. N., Plymouth, Mass.

No. 268.—ELECTRIC THAWING.—The water pipes to a motor-driven pump became frozen and electric thawing was tried, but with no favorable result. The pipes were three inches in diameter and about 60 feet long; they were partly underground and partly submerged in water. How should the thawing apparatus be arranged and how much power should be applied and for how long a time?—H. S., Verdun, Que., Canada.

No. 269.—CHANGING OVER FAN MOTOR.—I have an 8-inch, 110-volt, direct-current, Western Electric fan motor which I would like to change into an alternating-current motor to run on 110 volts, 60 cycles. Can this be done and, if so, how?—C. G. L., Minneapolis, Minn.

No. 270.—POWER-FACTOR ON DISTORTED WAVE.—When a wave of alternating current is distorted (as by variable resistance) to a different shape from the electromotive force, the power-factor is reduced below unity. How can one tell in such a case whether the current is a leading or lagging one?—P. N. C., River Forest, Ill.

Answers.

No. 259.—RELATIVE COST OF MANUAL AND AUTOMATIC TELEPHONY.—What is the relative first cost of manual, central-energy exchange and substation equipment for, say, 10,000 telephone lines and of full-automatic equipment for the same number of lines? What is the relative operating and maintenance cost of the two systems? Does the reduction in operating cost of automatic equipment offset the increase in fixed charges?—H. L. F., Buffalo, N. Y.

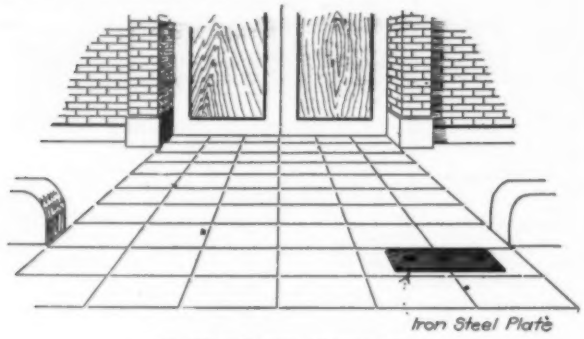
On account of the varying local conditions, which cause great changes in apparatus and initial cost, it is not practical to give the cost of a 10,000-line automatic telephone plant. Automatic plants are not sold upon the basis of initial cost. The initial cost is very often greater than that of the manual plant. However, for a 10,000-line system the automatic has been conclusively proven to be cheaper as regards the total cost of giving service than a manual plant serving the same conditions. This statement is based upon the inclusion of all expenses, including the interest on increased investment.—A. B. S., Chicago, Ill.

No. 264.—GARAGE ALARM.—At a garage located in a residence district much annoyance has been caused to the neighbors during the winter nights by the practice of drivers loudly sounding the horn to call the attendant to open the doors when they wish to return their cars to the garage. Is it not possible to devise some electrical arrangement whereby a bell or gong will be automatically rung inside the garage as soon as a car arrives at the door without compelling the driver to leave his seat?—F. E., Evanston, Ill.

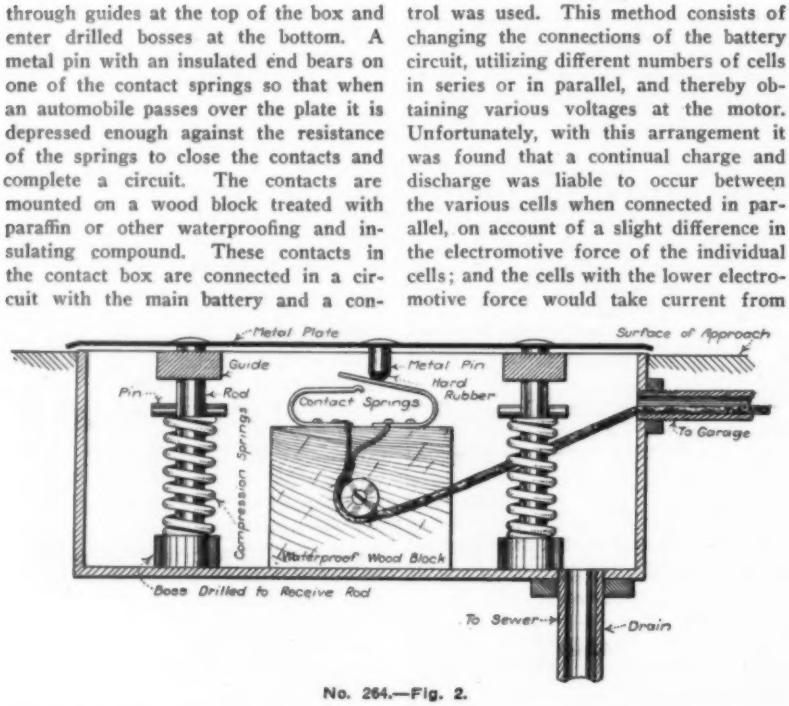
Where garages are located in residential districts, much annoyance is frequently experienced by the "honking" of horns on incoming automobiles as a signal to open the doors of the garage. This fact led the writer to devise a system of automatic signaling accomplished by the weight of the car as it entered the approach to the garage. The idea was carried still further so that the doors could also be opened automatically. This latter scheme will be described in a separate article.

Fig. 1 (next page) shows location of contact-making device, which is set in concrete in the approach to garage, with a beveled-edge steel plate over it and raised only about one-eighth of an inch above the pavement level. The plate should be about two feet in length and six inches wide and so placed that the wheels on one side of the automobile will pass approximately over the center of the plate. Details of the contact-making device are shown in Fig. 2. It consists of a cast-iron box, approximately the dimensions of the steel plate and about six

inches deep, which contains the contacts and two stiff steel compression springs. The bottom of the box should slope to a drain pipe connected with the sewer. A conduit connection should be provided for the wires leading into the garage. The springs should be stiff enough to support the weight of a pedestrian, but should respond to one-fourth the weight of an automobile. The plate is supported by two metal rods with pins inserted in them which rest on the springs. The rods pass through guides at the top of the box and enter drilled bosses at the bottom. A metal pin with an insulated end bears on one of the contact springs so that when an automobile passes over the plate it is depressed enough against the resistance of the springs to close the contacts and complete a circuit. The contacts are mounted on a wood block treated with paraffin or other waterproofing and insulating compound. These contacts in the contact box are connected in a circuit with the main battery and a continuous-ringing attachment, which can be secured from any electrical supply dealer. When the main circuit is closed the ringing attachment or relay releases and closes the local circuit through the gong which will continue to ring until the ringing attachment is opened or reset by hand. The connections are shown in Fig. 3. A bell-ringing transformer can be used instead of the batteries. A push-button at the door for use by pedestrians may also be connected to the gong circuit.—Norman G. Meade, Chicago, Ill.



No. 264.—Garage Alarm.—Fig. 1.

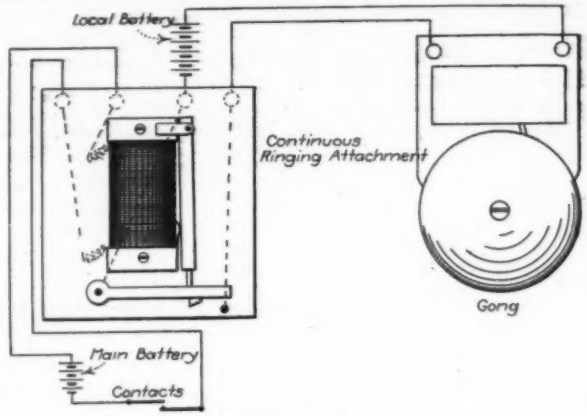


No. 264.—Fig. 2.

No. 265.—Electric Vehicle Control.—In the older types of electric vehicles it used to be the custom to connect up the battery in some sort of series-parallel arrangement, I believe, which was claimed to be very efficient. Is this system still used to any extent and, if not, why not? —J. T. S., Yonkers, N. Y.

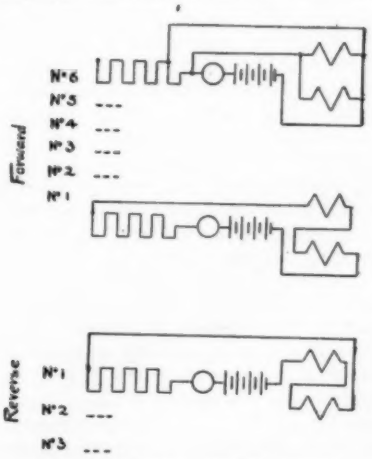
In the earlier types of electric vehicles the commutated-battery system of control was used. This method consists of changing the connections of the battery circuit, utilizing different numbers of cells in series or in parallel, and thereby obtaining various voltages at the motor. Unfortunately, with this arrangement it was found that a continual charge and discharge was liable to occur between the various cells when connected in parallel, on account of a slight difference in the electromotive force of the individual cells; and the cells with the lower electromotive force would take current from those with the higher electromotive force until an equality of voltage existed. As is to be expected, this charging and discharging back and forth between the various cells resulted in a loss of efficiency, which was found to be greater than that encountered with rheostatic control.

The commutated-battery system is no longer used to any great extent for obtaining speed variation of electric vehicles, practically all controllers now being arranged to cut in resistance in shunt to the series field winding of the motors, and by this means enabling a greater number of speeds to be obtained at a higher efficiency. The accompanying sketch shows an arrangement for obtaining different speeds by resistance, and by cutting in the fields in series or parallel. There are six forward speeds and three reverse, but only the two extreme forward speeds and the first reverse speed are shown in the diagram.



No. 264.—Fig. 3.

The older types of controllers broke the motor circuit when changing speeds, but the type of controller now in most use permits of its being cut from point to point throughout its range without opening the motor circuit, thus enabling the motor to maintain a certain amount of torque during the throw-over. The result of this arrangement is to increase the mileage and life of both batteries and tires, and materially to reduce the wear and tear on motors, chains, contacts, etc. —I. L. K. R., Chicago, Ill.



No. 265.—Electric Vehicle Control.

Following an address on "Safety First," by Mr. Whiting, of the Massachusetts Employes' Accident Insurance Association, at Brockton, Mass., last week, the employees of the Edison Electric Illuminating Company, of that city, organized a safety committee.

American Institute of Electrical Engineers.

Midwinter Convention, New York City, February 17-19, 1915.

The third midwinter convention of the American Institute of Electrical Engineers was held at the Engineering Societies Building, New York City, February 17, 18 and 19. The opening session was called to order by President P. M. Lincoln at 10:20 a. m. on Wednesday, with about 60 members present. This attendance was increased somewhat at later sessions, the total registration amounting to 460.

President Lincoln's introductory address dealt with the functions and the development of engineering societies, whose greatest value he stated to be in the exchange or transfer of information. The value of an idea is nil unless it is communicated. Ideas grow by exchange, but die by hoarding. He consequently exhorted his hearers to bring their best ideas to the meetings of the Institute.

The remainder of the session was devoted to a symposium on "The Characteristics of Electric Motors," which was opened by D. B. Rushmore. Mr. Rushmore gave statistics showing the rapid increase in the use of motors in indstrial applications, and summarized the advantages of electric-motor drive. He gave a classification of motor types, indicated their limitations as they affected rating, and pointed out the differences in speed and torque characteristics, mechanical features, and operating features. This paper served as an outline upon which the remarks of the succeeding speakers were based.

A. C. Lanier discussed the subject of direct-current motors, which are particularly valuable on account of their flexibility and diverse characteristics. These have been their salvation in competition with induction motors. A large number of curves were given, illustrating these characteristics, and the arrangements for obtaining adjustable speeds and other desired features were discussed. The use of commutating poles especially was considered. Mr. Lanier also submitted a written discussion by Albert Brunt.

K. A. Pauly discussed the flywheel effect, which is often utilized for storing small amounts of energy for a short time. To utilize this effect greater changes in speed must be allowed than would otherwise be tolerated. A cumulative compound winding is usually used for direct-current motors, and rotor resistances inserted in induction motors. Curves were given illustrating applications of the flywheel effect.

E. F. W. Alexanderson submitted a written discussion of alternating-current commutator motors, which was not read, although lantern slides were shown illustrating the characteristics of this type of motor, including the polyphase commutating motor.

C. J. Fechheimer contributed a paper dealing with synchronous motors. The characteristics of this motor, originally regarded as objections to it, are difficulties in starting, tendency to hunt, and the necessity for direct-current excitation. These have now been overcome. The motor is made self-starting by the use of a squirrel-cage winding, which also eliminates the tendency to hunt. Where direct current is not otherwise available, a separate exciter may be driven by the motor itself. Its principal advantage is its fixed speed. It is not very suitable for types of load like blowers, where a large torque is required in starting and up to nearly full speed. The design is usually such that double the normal torque is required to make it fall out of step. There is not much demand for this type of motor in the smaller sizes, as the rotor temperature is a serious limitation, and induction motors can be built more cheaply. In large sizes, however, there are certain applications to which it is especially suitable, such as low-speed air-compressors, as a motor in motor-generator sets and in frequency-changers; as a synchronous condenser, etc.

F. B. Crosby discussed the speed characteristics of different types of motors, illustrating the characteristics by lantern slides of various curves and diagrams. He pointed out the types of motor suitable for constant speed, for variable speed, and for adjustable speed. To secure the latter in an alternating-current motor is not easy, but he described a type, or rather, combination of machines in which this could be effected by what he designated as dynamic control.

Andrew E. Averrett discussed the characteristics of the induction motor. This is normally a constant-speed machine, but variations can be made in its design to give other speed characteristics. Thus, through resistance control, it can be made to resemble a series motor. He dwelt upon the improvement of the power-factor, and pointed out how it falls off in case of low loads or low speeds of operation.

Lee F. Adams discussed the subject of motor bearings, pointing out the essential requirements of their design, the troubles that are likely to arise in operation, the kinds of oil and methods of oiling available, and the application of ball bearings and roller bearings. The latter are especially advantageous in the case of low-speed machines.

Comfort A. Adams presented some general discussion, pointing out the limitations of the commutating-pole motor. Some persons seem to think that this type will commutate in any condition of operation, but owing to saturation of the pole and magnetic leakage this is not the case, and there is a certain percentage of overload beyond which such a motor will not commutate satisfactorily. Similar misconceptions frequently arise regarding changeable-pole motors and concatenated motors. If the number of poles of an induction motor is changed, the constants of the machine are greatly altered, and the operating characteristics necessarily changed also. The same thing, in general, is true of concatenated motors. Neither of these two cases represents the most economical application of the motor capacity involved.

At the afternoon session the first paper presented was by L. E. Imlay, entitled, "Effect of Moisture in the Earth on Temperature of Underground Cables."

Effect of Moisture on Temperature of Cables.

A permanent installation was made for supplying moisture to the earth in the neighborhood of underground cables with the object of reducing their temperature. The approximate temperature of the cables is found by taking with a resistance thermometer the temperature of a duct adjacent to the cable which is the source of heat. In uncovering the conduits and exposing them to air, as a remedy for hot spots in the cable, it was found that the adjacent earth was hot and dry so that it crumbled to powder. This suggested opening a ditch in the ground above the conduit and directing a stream of water through it. This was found to lower the temperature immediately several degrees. Where an open conduit was not practical, water was discharged in to a vacant cable duct by means of a hose and this was found to be more effective than the open ditch. These experiments led to the installation of a line of porous tile duct in the earth above the conduit, surrounded with clean sand. The leakage of water through the pores of this duct has been found very effective in reducing the temperature of the cables. Whenever the temperature of the cables is found by exploring with a resistance thermometer to approach the danger point, water is turned into the porous

drain tile, and the temperature is taken on successive days to see whether the desired reduction has been obtained. In this way one or two men, with resistance thermometers attached to long leads, can keep track of and control the temperature of the cables in a large system. No breakdowns of insulation of cables have occurred due to high temperature since the adoption of this method.

The discussion was opened by Henry W. Fisher, who computed that the amount of water used by the author would be just about sufficient to carry off by convection the heat generated. He also presented a written discussion by Charles W. Davis, describing experiments which were made to determine the temperature in the ground three feet below the surface, and the precautions necessary to prevent errors in doing so. This temperature is greatly affected by the nature of the surface and by percolation of water. City streets receive a maximum of solar radiation and but little water; hence higher temperatures are observed here than elsewhere. The curve he obtained was similar to that of Mr. Imlay, the maximum temperature, in August, being 68 degrees, and the minimum, in March, 37 degrees.

W. S. Clark stated that in Schenectady the temperature three feet below the surface will reach the freezing point of water during the winter. He referred to an old tie line in Chicago where water had been used for cooling, and to a conduit in St. Louis, where the temperature only varied two degrees in 24 hours on a sunshiny day. The clay around this conduit was baked by the heat. He thought waterproof ducts should be used, so that wet soil would not be objectionable.

Philip Torchio referred to a cable which could not be loaded as high in summer as in winter, and the effect of the surrounding soil upon the temperature.

W. S. Franklin pointed out that the condition of soil with respect to moisture, and its variations with time, could be determined by measurements of the electrical conductivity of the soil.

P. W. Sothman referred to the use of unglazed conduits in Europe, and the claim that heat was dissipated from them much better than from the waterproof type.

G. N. Lemmon told of a case at Youngstown, O., where a cable was fused at the point where it passed under a car barn and was surrounded by dry earth and ashes; whereas the portion under the sidewalk, which was exposed to greater moisture, was not affected.

Messrs. Windringham and C. A. Adams also joined in the discussion.

The next paper was entitled, "Oil Circuit-Breakers; Notes on Arc Phenomena and Tendencies in Design," by K. C. Randall.

Oil Circuit-Breakers.

With an ideal oil circuit-breaker the current will not continue after the first zero value following separation of contacts. If the separation is not sufficient, or condensation and removal of gases not adequate, or there is a sufficient quantity of volatilized metal in the arc, the current will be re-established. Each time it is re-established energy is dissipated. The oftener this is repeated, the more the contacts are burned, the more the oil deteriorates, and the less the chance of final interruption. The energy dissipated is generally proportional to the frequency. At higher potentials, insulation problems largely govern the dimensions. At lower potentials, mechanical considerations dominate. Length of break is important. Except for arc gases it need only be slightly greater than the oil distance which the available potential would puncture. In practice it may be up to ten times this value. A number of breaks in series seems desirable. Accelerating devices for rapid opening and closing are now common. Modern practice favors solenoid operation for remote-controlled breakers. The maximum power that plain breakers now built could rupture is about equivalent to a short-circuit on generators rated at 150,000 kilovolt-amperes. It is best handled at about 15,000 volts. In endeavoring to raise the power limit, resistance and reactance breakers were developed. The latter has proved most suitable, being placed in shunt with one break, with a second break in series. The present tendency is mainly to improve mechanical details, giving increased strength of tanks, rapid contact separation, provision for vented expulsion chambers, arrangement for replaceable contact parts, employment of larger-capacity pole units. The question of rating was also considered.

This paper was discussed by W. S. Franklin, Philip Torchio, H. R. Summerhayes, and P. M. Lincoln.

Mr. Torchio told of a circuit-breaker exhibited at the Turin Exposition, in which the oil was under pressure.

Mr. Summerhayes pointed out that the pressure at the arc could probably not be increased over the value produced by the arc itself. With two breaks in series, he thought it better not to have any reactance in shunt. He claimed that motor operation of circuit-breakers was quite as efficient and satisfactory as solenoid operation.

Mr. Lincoln pointed out that reactance, rather than resistance, was used in shunt with the break on account of the large size of resistor which would be necessary.

In closing the discussion, Mr. Randall said that resistance had been tried for this purpose, but reactance had been found more suitable. He favored a reactor in series, rather than in parallel with the break, as this would relieve the circuit-breaker; but operators do not desire this. The cases of circuit-breakers are sometimes sealed, without any vent, but in that case it becomes necessary to have an air cushion.

A paper was then presented by F. W. Peek, Jr., entitled, "Comparison of Calculated and Measured Corona-Loss Curves."

Comparison of Calculated and Measured Corona-Loss Curves.

Corona loss curves made on a number of experimental and practical lines by different investigators have been corrected and plotted. The loss has been calculated by the quadratic law, $p = c\ (e - e_0)^2$, for each case under the same conditions as to spacing, conductor diameter, altitude, etc., and plotted for comparison. It is of interest to note that the measured values were made at various parts of the country. The time period covers a number of years and the altitude varies from sea level to 10,000 feet. An exact check of calculated and measured losses cannot be expected, as the exact conditions are not always known as to conductor surface, wave shape, etc. Such losses are also difficult to measure, especially on practical lines where the voltage range is quite small and there are a large number of corrections to make. The check is as close as the accuracy of the measurements permits. The variations from the calculated values are in most cases due to the fact that practical measurements have been made on the unstable part of the curve below the visual critical-voltage value. The losses at this part of the curve are fully discussed.

This paper was discussed by J. B. Whitehead and Philip Torchio. Dr. Whitehead thought that the equation for corona loss should not be applied below the point at which visible corona appears. Experimental values below this point seem to be very erratic, some being larger and some smaller than the computed values. There is no experimental evidence for such a point as is represented by the value for disruptive voltage appearing in the equation. Laboratory experiments indicate that there is no loss without ionization, and the latter takes place gradually. It does not start suddenly and jump to a specified value, even with cleaned wires, as was indicated by the author. The voltage of a transmission line should be chosen with a recognition of the irregularities taking place below the voltage of visible corona.

In closing the discussion, Mr. Peek pointed out that the value e_0 is determined from observations at higher voltages, where there is very little experimental error. In answer to a question by Mr. Torchio, he stated that the potential gradient for very short distances was very greatly increased above the value applying to larger gaps, and it might reach a value of 250,000 volts per centimeter for a gap of 0.001 centimeter between spheres. The distance at which this gradient becomes variable depends upon the radius of the spheres.

A paper by Charles I. Burkholder and Nicholas Stahl, entitled "A 100,000-

Volt Portable Substation," was then presented by Mr. Stahl.

A 100,000-Volt Portable Substation.

Expanding needs of the Southern Power Company system, paralleled by many miles of railroads, required a flexible-connection portable transformer station of large capacity, and self-contained on a single car. The equipment in operation is of 4,000 kilowatts and provided with high and low-tension switch gear, instruments, panel, wiring and cables, oil-insulated, self-cooled transformers with motor-driven blower for forced air draft, special means of establishing the high-tension delta with 100,000-volt clearances, after transformer terminals and high-tension switches have been raised by a portable derrick, from receptacles where all fragile parts are protected from malicious tampering. Besides meeting standard freight-car requirements for transportation, substantial, specially braced trussed superstructure is provided for supporting cabs and switch-gear, which latter, as well as transformer terminals, must be lowered, during transit, to meet railroad clearances. Unusual flexibility of voltage connections is secured, contributing largely to the successful operation. Current for lights, instruments and blower motor is obtained from auxiliary transformer windings incorporated with the main units. Low-tension arrangements allow operation at various voltages with minimum switching. The entire equipment is designed for simplicity and dispatch in disassembly for transit, and reassembly in new location. It is used for breakdown service, spare capacity, temporary replacement of distributing or tie-in substation during enlargement or rebuilding, emergency service for central stations or isolated plants, tentative service for prospective customers, pioneer service, etc.

This paper was discussed by K. C. Randall, J. C. Smith, and L. W. Chubb. In answer to their questions, Mr. Stahl stated that lightning arresters were not necessary, as portable substations had the protection of the arresters connected with the permanent stations to which they were connected. Electrolytic arresters would be subject to slopping of the liquid in transport, so that a less efficient type would have to be used; and anyhow, the car was about full. Single-phase transformers were used in preference to one three-phase transformer, because that is the universal practice of the Southern Power Company; and, moreover, in case of a fault in one transformer, the other two can be operated in open delta. There was no room on the car for an oil switch, and it would also be liable to slopping.

The Status of the Engineer.

On Wednesday evening the session was devoted to the subject, "The Status of the Engineer." President P. M. Lincoln occupied the chair, and an opening address was made by Lewis B. Stillwell. Mr. Stillwell did not attempt to cover the subject comprehensively, but, in introducing it, spoke principally regarding coordinated policy and action by the several large engineering societies of the country. He pointed out that engineers have not taken the active part in public affairs which was justified, and, as a result, both public and law-makers are hopelessly befogged on such questions as the conservation of waterpower. Engineering quesitons should not be left to politicians for settlement, but the engineer should assert himself as a citizen. If he buries himself in his professional work, he can not be a leader of men. While recognition for the engineer may lag behind achievement, every achievement has an influence in bringing recognition.

With regard to improving the status of the engineer, he thought that, first of all, students in the technical schools should be given less technical knowledge and more mental training. He favored a four-year college course preparatory to two years of engineering study. The exclusion of undesirable men from membership in the engineering societies is another step that should be taken. While several of the societies have codes of ethics, these do not at present carry very great weight. The societies should discipline members who violate their codes, and dishonest members should invariably be expelled, as is done by legal associations. A definite policy regarding the licensing of engineers should be adopted jointly by the various engineering societies, which heretofore have been divided on this subject. Engineers should also endeavor to direct public policy along economic lines.

The next speaker was E. W. Rice, president of the General Electric Company, who included in the term "engineering" chemists, sanitarians, and others whose efforts lay along similar lines. The engineer has done more than any one else to change the activities of civilized peoples, and he should feel the responsibility which accompanies such things. The engineer is commonly supposed to lack executive ability, salesmanship, financial ability, etc. He pointed out that the qualities of integrity, intelligence, common sense, and others that go toward success in life are not professional, but personal, qualities. The engineer deals largely with nature, which leads to his slighting human affairs sometimes. While engineers do not always agree in their opinions, these opinions are always based upon facts, and the engineer is always ready to consider facts. He consequently blends, in an excellent manner, conservatism with radicalism. Since he must be honest with nature, and with himself, he is naturally honest with his fellows, and men of this type are greatly needed in business affairs, both large and small. The old type of salesman is being largely displaced by the engineer-salesman. There is a still bigger field for the engineer in business and public affairs. Engineers should have a large part in the conduct of these affairs, and also in making the rules under which business is done. He pointed out that the United States Senate is made up of lawyers to the extent of 75 per cent of its membership, and the House of Representatives 68 per cent, with but a single engineer in its membership. The situation in the New York State Legislature is similar. Since engineers have such a large part in determining the ordinary affairs of life, they should have a much greater part in governmental affairs.

The next speaker was E. M. Herr, president of the Westinghouse Electric & Manufacturing Company. Mr. Herr said that the engineer stands for progress and improvements. The old definition of engineering must be extended to include men. We now have the efficiency engineer, who is concerned with the management of men. Both this field of management and commercial lines are now being opened to engineers, since the training which an engineer receives is needed in both of these activities. The relation of cause and effect must be considered in dealing with men, as well as in dealing with materials. The engineer is well fitted for this, except for his tendency to depend upon mathematical analysis, which is not applicable to human relations.

Alexander C. Humphreys, president of the Stevens Institute of Technology, was the next speaker. He placed great emphasis upon character. He thought students in technical schools should be well grounded in fundamentals, but that specialization should be left until after graduation. He pointed out that much material now goes into the transactions of the engineering societies that needs to be digested, and much more that should be contradicted. The industrial problems of this country now confronting us require solution if we are to have prosperity, yet the engineer and the industrial worker are among those least considered in working out these problems. He quoted Senator Root as saying that entirely too many laws are passed, and there are too many lawyers in legislative bodies. It is partly the engineer's own fault that he does not have a larger part in civic affairs, as he should have. Along with his education and training goes the responsibility to apply his talents in helping to direct public affairs. He concluded with a plea for greater engineering representation upon public-utility commissions. Engineers have a better judicial train-

ing than lawyers, who usually have the point of view of advocates.

George F. Swain, professor at Harvard University, was the next speaker, and he agreed that engineers are not appreciated and do not have the leadership in public life which they should have. He then analyzed the reasons for this condition, and the remedies. He stated that the engineer was, on the average, as well paid as the members of other professions, and the fees today are much larger than they were 20 years ago, although the maximum fees do not equal those in the legal and medical professions, because the emotional elements of love, hate and avarice are not involved. While this is an age of applied science, law and business are also necessary, and there is no inherent reason why the engineer should lead and be the employer, rather than the others. This is a question of personality, and if the engineer does not lead, it must be because he lacks the personal qualities, such as character, tact, ability to handle men, breadth of vision, and presence. These things are partly due to training, and there is no reason to suppose that any one class of men are inherently more capable than another. However, many of the more capable men choose a business career. They should be encouraged to go into engineering. He did not think the engineer was trained to think any straighter than the lawyer or the business man. A lawyer is very careful to consider the exact meaning of words, and he also studies both sides of his case. He therefore gets a better mental training. He also usually has a greater breadth of view than the engineer, who is apt to become too absorbed in details. He agreed that the curriculum of an engineering school should cover mainly the fundamentals and English, and give less time to technical details. The fact that engineering is so largely mathematical is one reason that the engineer has not been more prominent in dealing with human problems. He needs a broad outlook upon the world, involving the study of history, psychology, etc. The engineer of the future should be trained in the qualities which go to make up personality.

Henry G. Stott followed Professor Swain, and stated that he considered the status of the engineer fairly satisfactory, except in relation to government work, where he is not properly recognized, and the credit for his achievements goes to some executive officer in charge of the work. Engineers may be divided into two large classes—those who specialize in one or two branches and who have their reward in their achievements, and those who shift to executive positions. He said that the definition of engineering must be enlarged as follows: "The art of organizing and directing men, and utilizing the forces of nature for the benefit of the human race."

The last address of the evening was by J. J. Carty, who pointed out that all of the engineer's work is of the co-operative kind, as he must co-operate with others, either within or outside of his own profession. He must always deal with men as well as with things, and his purpose always is to increase the productivity of labor. He pointed out that the design of labor-saving machinery involves not only mechanical ability but economic problems, since the device designed must save more per annum than the annual charges on its cost. He called attention to the great influence of the modern developments in transportation and in communication upon the life of the nation, and said that these things had reacted upon the engineer himself. The varieties of engineering have greatly multiplied in number, but he did not include in them the efficiency engineer, who, he said, dealt really with the science of management; and management should be distinguished from engineering.

The first paper on Thursday morning was by Frederick Bedell and E. C. Mayer. It was entitled "Distortion of Alternating-Current Wave Caused by Cyclic Variation in Resistance," and was presented by Professor Bedell.

Distortion of Current Wave Caused by Cyclic Variation in Resistance.

An alternating current flowing through an unvarying non-inductive resistance has a wave-form that is undistorted and is identical with the wave-form of electromotive force. If the resistance varies during each cycle on account of changing current and temperature the current wave will be distorted and will contain a third harmonic that will flatten the current wave when the temperature coefficient is positive and will peak the current wave when the temperature coefficient is negative. If there is temperature lag in the resistance the third harmonic of the current will be retarded in phase, and likewise cause a slight shifting of the fundamental of current with respect to the electromotive force. Due to this distortion of current wave power-factor becomes less than unity and a vector diagram in more than two dimensions is required to show the true relations between current, electromotive force and power-factor. These conclusions, reached theoretically, conform with the experimental facts so far as known.

The discussion was opened by C. H. Sharp, who spoke of the bearing of the paper on tungsten lamps operating with alternating current. He referred to experiments in which he had found a noticeable difference in the resistance of such lamps with alternating and direct current, but this difference was very small, and the power-factor was very slightly affected.

John B. Taylor referred to the cyclic changes in resistance which take place in the telephone transmitter, where, with a source of direct current, the current changes follow the same cycle. In the wireless telephone the source is high-frequency alternating current of, say, 100,000 cycles, whereas the resistance changes at the rate of perhaps 1,000 cycles per second. It has been proposed to use current from a low-frequency source in the ordinary transmitter circuit. While speech can be understood under such conditions, musical tones are no longer transmitted at their original pitch, but apparently differential tones result. He pointed out that the third harmonic found by the author is a purely mathematical quantity, without physical significance, since the physical change corresponding to it takes place only once per half cycle.

Crosby Field-Frank pointed out that the author had dealt with circuits in which Ohm's law is fulfilled. This is not the case in the coherer, which presents an interesting case of cyclic change in resistance. He presented a diagram illustrating the hysteresis loop obtained under these conditions, referring especially to carborundum, which has a negative temperature coefficient of resistance.

L. W. Chubb referred to the energy equation applying to an incandescent lamp, and pointed out that a third harmonic was indicated in the current variations.

After some remarks by C. R. Underhill, Professor Bedell closed the discussion.

The next paper was entitled "Dimmers for Tungsten Lamps," by Alfred E. Waller.

Dimmers for Tungsten Lamps.

The advent of tungsten lamps for theater lighting made necessary a complete re-design of the dimming apparatus. Dimmers designed for the control of carbon lamps do not give smooth and flickerless regulation when used with equal loads of tungsten lamps. This is due to the temperature coefficient of resistance of the lamp filaments, that of the carbon filaments being negative, and that of the tungsten filaments positive. Curves are shown to indicate the change in lamp resistance and candlepower for various watt inputs. Curves for both carbon and tungsten lamps are shown in order to bring out the contrast, and a method described for determining the resistance per step and number of steps in the dimmer designed for control of tungsten lamps. Steps of one volt are found to be the largest which are satisfactory for 110-volt lamps. The author gives a brief indication of mechanical requirements in dimmer design.

The discussion was opened by Leonard Kebler, who stated that, after the

determination of the resistance steps, the most important points of design had reference to the contact shoes. On account of the lack of lubrication, the rubbing surfaces should be of different materials. He preferred making the shoes of copper and the stationary contacts of brass. The same considerations apply for the bearing surfaces of the rheostat arms. These should have no lost motion.

C. D. Knight discussed the best resistance steps to use in the rheostat, and came to conclusions slightly different from those of the author. It is sometimes necessary to light a theater stage very gradually. This involves the use of a resistance in the dimmer equal to five times the hot resistance of the lamps.

H. Ward Leonard stated that dimmers should be built compactly, and that each element should be worked at its maximum capacity. He referred to the history of the subject, and cited the installation in McVickers Theater, in Chicago, in 1885, which was the first interlocking dimmer constructed. This took about 20 times the space which is required today for an equivalent installation in plate form.

John B. Taylor, Comfort A. Adams and W. S. Franklin also joined in the discussion.

In closing Mr. Waller stated that the scheme of gradually changing the current in one of two lamps until the difference was just noticeable had been tried, but that the eye can distinguish smaller changes in the resulting illumination than are indicated by this method. Steps of one volt give an imperceptible change. Even steps of one volt, however, represent a more rapid change at one end of the range than at the other, and consequently the rate of shifting the rheostat is varied by the stage electrician.

C. S. McDowell then presented a paper on "Searchlights."

Searchlights.

Searchlights have remained practically the same for the past 25 years, although there is great necessity of an improved searchlight on account of the increased range of torpedoes and increased speed of torpedo boats. The constituent parts of a searchlight are given in the paper, and some of the essential and desirable features of the various parts are shown. Methods of testing searchlight mirrors are given, with illustrative figures. The results of tests conducted on Navy standard 36-inch and 60-inch searchlights and Beck 44-inch searchlight show the latter type to be much more efficient in illuminating distant objects. Relative results are shown in the figures. In the Beck lamp the carbons are rotated and are bathed in an inert gas. The positive holder is fixed, the carbon being fed through it at the rate of consumption; the rate of feed is automatically controlled. The negative carbon is controlled by hand. Current is supplied through roller contacts. The positive carbon is cored with a rare earth of very high melting point. Its area is 201 square millimeters. The maximum intrinsic brilliancy is over 438 candlepower per square millimeter. The light is of more bluish white than ordinary, and the beam more concentrated. The maximum candlepower is 88,000, as against 45,000 with others.

E. H. Martindale presented written discussion by R. B. Chillas, Jr., who has carried out a large number of experiments with searchlight carbons. He referred to the dependence of efficiency upon the length of arc, which is limited by the stability of the arc and the permissible frequency of outages. The nature of the negative carbon is important in this respect, and a proper selection gives a steady arc and consequent increased arc length. He had found the best form to be a tapering tip, which is copper-plated to give better conductivity. The diameter can then be reduced. In the Beck lamp the crater has an area of about 200 square millimeters. The most improved electrodes for the Navy type of searchlight have a total cross-section of 650 square millimeters, but on account of the spindling, the actual area of crater is only 280 square millimeters. These electrodes have given much better results than those quoted in the paper. There is also less wandering of the arc, which remains in the focus of the reflector. He suggested the use of a fixed feeding ratio, using a chain gear with an idler, which would take care of irregularities and departures from the assumed ratio of consumption. A table of dimensions of the old and the new standard carbons for 36-inch and 60-inch searchlights was given. He then explained a rapid method of photometering searchlights by the use of the integrating sphere.

Karl G. Frank referred to the excellence of the Siemens-Schuckert regular factory output of mirrors, which had been computed for them by Professor Munker. He disputed the statement that carbon volatilized at 1,800 degrees, and considered that any effect obtained at this temperature was due to the carrying of carbon particles in the arc stream. He referred to the work of Lummer in measuring the arc temperature at different pressures. The latter found no vaporization up to 3,000 degrees centigrade. Under a pressure of 22 atmospheres he had carried the temperature up to 6,000 degrees centigrade, and he thought he had obtained liquefied carbon. The results obtained with the Beck lamp were due largely to the high temperature attained. The Siemens-Schuckert Company is also using smaller negative electrodes of 40 millimeters diameter, and these have been supplied to the new Argentine battleships. He referred to the effect of atmospheric absorption upon the results attained, this absorption varying from 2 to 50 per cent, or even higher in case of fog. In the Mediterranean the range is much larger than in the Baltic Sea, for instance. A 90-centimeter searchlight ordinarily has a range of about one mile.

H. A. Hornor spoke of the good work done by government engineers in investigating apparatus used, and the importance of the advances made in searchlights.

Richard Fleming pointed out that a small electrode permits better focusing, because it prevents wandering of the crater. It also gives a higher intensity. He thought that the disappearance of carbon at 1,800 degrees was due to oxidation rather than vaporization. He preferred a clamping contact to the roller contacts used on the Beck lamp.

W. S. Franklin pointed out that if the source of light is not a point, there is no shape of reflector which will prevent a conical beam of light.

C. H. Sharp said that the parallel beam of light which would result from a true point source and parabolic mirror was not desirable, since too small an area would be illuminated to be visible at a great distance. The size of the crater determines the divergence of the beam. The brightness of the crater should be as high as possible, and then extension of the surface is an advantage, since it results in the illumination of a greater area. The advantage of the Beck lamp is a higher specific brightness over the entire end of the carbon electrode.

In closing the discussion, Lieutenant McDowell stated that the electrodes used in the tests were what were standard in the Navy at that time. Since then smaller sizes of electrode have been used, resulting in a steadier arc and more useful light. The Beck lamp requires no more attention in use than the ordinary searchlight. The gaseous atmosphere surrounding the electrodes is produced by the vaporization of alcohol under each electrode. This is accomplished by the use of an electric heating coil. The mirror of the Beck lamp was less perfect than those on the other types, so that the advantage existing could not be due to this element.

Electrical Precipitation.

The session on Friday morning was devoted to electrical precipitation. The subject was introduced by F. C. Cottrell, who explained the organization and objects of the Research Corporation, which was incorporated under the auspices of the Smithsonian Institution to prosecute work along this line. He also referred to a somewhat similar

institution founded through the initiative of Dr. Duncan, and known as the Mellon Institute of Industrial Research. The latter organization has dealt principally with the subject of black smoke, whereas the Research Corporation has investigated principally the subject of smelter fumes. The two institutions are co-operating in their division of the work. Dr. Cottrell indicated that future work would deal also with the subject of dispelling fog, which Sir Oliver Lodge has already demonstrated is feasible. The applications which receive the support of commercial interests were those which were naturally taken up first, whereas the developments which are rather a matter of general public interest will follow later. It has been planned to carry out demonstrations and experiments at San Francisco during the Panama-Pacific Exposition.

W. W. Strong then presented a paper entitled "Electrical Precipitation—Theory of the Removal of Suspended Matter From Fluids." This was followed by two other papers and all were discussed together. "Theoretical and Experimental Considerations of Electrical Precipitation," was presented by A. F. Nesbit, and "Practical Applications of Electrical Precipitation and Progress of the Research Corporation," by Linn Bradley. Each of the speakers used lantern slides to illustrate his subject, and the two latter also made use of motion pictures. Mr. Bradley also gave a demonstration of the precipitation of both white and black fumes, which were generated upon the platform and caused to rise through a pipe. This pipe formed one electrode and a wire suspended in its axis formed the other electrode of a circuit, which was supplied with current at 40,000 volts. This current was first rectified by passing through a mechanical rectifier driven by a synchronous motor. The corona which occurs around such a wire was also demonstrated.

Theory of the Removal of Suspended Matter from Fluids.

The frictional resistance of a small particle moving through a fluid is given by the law of Stokes. Knowing the density and size of the particles and the coefficient of viscosity of the medium, the amount of energy required to remove suspended matter from fluids can be calculated. From the formulas the relative efficiencies of the different methods used to remove suspended matter from gases can be obtained. From these formulas the electrical method is shown to be especially adapted to fine suspended particles or to a mixture of gases that can be selectively ionized. In a practical case of electrical precipitation of smoke it is shown that approximately 4 per cent of the energy of the corona discharge is actually expended in the process of precipitation. The distribution of the energy of the corona discharge is discussed. The nature of the ionization is also briefly described. The application of the theory of electrical precipitation is given so that it is possible to determine the best working conditions for precipitating a given kind of suspended matter from a given fluid. The theory also indicates the limits of usefulness of the method of electrical precipitation.

Theoretical and Experimental Considerations.

The theory of electrical precipitation of suspended matter in gases is inseparably connected with the phenomena of ionization and the laws of electrically charged bodies. The motion of the suspended particle is like that of the charged pith ball in familiar experiments, but the charge is obtained by ionization instead of contact. The paper shows that electrical precipitation occurs in nature and then by calling attention to the structure of matter shows how ionization is brought about, how the ions, nuclei and aggregates are formed, and the final precipitation of these is effected by gravitation and the electric field. Experimental apparatus for electrical precipitation is given and attention is called to the differences between the appearance of the positive, negative and alternating corona. The experimental data have shown the superiority of the negative corona and the relative effectiveness of the size and shape of electrodes, temperature and conductance of gases, polarity and uniformity of corona.

Practical Applications.

The technical and financial progress made by the Research Corporation since its organization in 1912 is given, and several plants are described. Voltages, electrode spacings, power consumption, etc., are given for several installations. Mention is made of a number of improvements in the electrical apparatus and means for its control. Progress has been made towards standardization of apparatus for this work. The paper is illustrated with photographs of installations in various stages of operation. Curves and charts show the peculiar character of the circuit, the method of obtaining data to be used in designing treaters and of conducting tests. Alternating current of 250,000 volts has been rectified and used for precipitating particles from gases. Fumes have been separated into fractions by means of temperature control and the electric processes. A selected bibliography is included.

These papers were discussed by W. S. Franklin, Saul Dushman, H. P. Hill, L. W. Chubb, John B. Taylor, J. H. Davis and S. M. Kintner.

Dr. Dushman called attention to the noise and other disadvantages of the mechanical rectifier, and pointed out that Langmuir has shown that a rectifier suitable for use up to 100,000 volts can be made by using a hot wire and a plate as electrodes in a vacuum tube. Current will pass between these only when the wire is the negative electrode. The efficiency of such a rectifier is about 95 per cent. It can handle currents up to 0.5 ampere, but where larger currents are necessary, a number of rectifiers may be used in parallel. Dr. Nesbit stated that this form of rectifier had already been used and found satisfactory.

Professor Franklin stated that precipitation through the force of the electrical field acting upon polarized particles was not feasible, because the necessary gradient becomes enormous when the particles are small. It is for this reason that corona conditions, causing ionization, are necessary.

Dr. Strong pointed out that the static influence machine was not to be considered for practical use, since a transformer weighing not over 75 pounds will supply 40,000 volts, and with the vacuum rectifier forms a very portable and compact apparatus. He stated, also, that precipitation through the effect of polarizing the particles was not practical. The action becomes better and better as the conditions for sparking are approached; that is, with the maximum ionization current. The electrical charge on a single particle probably amounts to 50 or 100 C. G. S. electrostatic units.

Dr. Nesbit said that the precipitation of smoke would be feasible upon locomotives standing in round-houses, but not when moving at high velocities.

In closing the discussion, Mr. Bradley, answering a question, stated that in the mechanical rectifier a long arc of contact is necessary to get sufficient ionization, although only the higher points of the wave may be active. Frequency has some effect, also, upon the most efficient design of the apparatus. He stated that the choice of voltage and other conditions must be made to suit practical requirements, and attainment of results was considered more important than efficiency in the use of power. Excessive voltages are avoided as far as possible, but are sometimes necessary on account of the large diameter of stacks. Unless a sufficiently high voltage is used, good results cannot be obtained. The design is usually drawn up to permit some flexibility with respect to the voltage and power used. The use of a reactance in the discharge circuit had been tried, without any especially good results. It was not considered necessary to install a condenser also, as the electrodes themselves constitute a condenser. As arcing between the electrodes does no particular harm, no special pains were taken to eliminate it.

Mr. Kintner pointed out that condensers for such high voltages are too expensive in proportion to the benefit derived from them.

The last session of the convention was called to order on Friday afternoon at 2:30 o'clock, and was devoted to the subject of "Electrical Porcelain,"

a paper with this title being presented by E. E. F. Creighton.

Electrical Porcelain.

Part I treats of the reasons for using the high-frequency oscillator for testing porcelain insulators. The oscillator is a combination of a 60-cycle transformer, a condenser, a spark gap, and an oscillation air-core transformer. The 60-cycle potential charges the condenser and the condenser discharges through the gap and the transformer. This sets up high-frequency wave trains of the same nature as the wave trains that take place on the transmission line. This high-frequency potential strain is the only kind that damages the insulators. The 60-cycle potential is always far below the puncture potential and arc-over potential of the insulators.

In Part II it is shown that the principal factors in the manufacture of porcelain which affect the final products are: (1) the choice of ingredients —ball clay, china clay, feldspar, and flint. (2) The problem involved in getting a homogeneous mixture of these pulverized materials. (3) The problem of drying out the moisture without causing unequal contractions which crack the green porcelain. (4) The early dehydration in the furnace in which as much as 14 per cent of moisture is given out. (5) Proper time and temperature for vitrification. The mechanical processes through which porcelain is carried are of the greatest importance in getting good electrical porcelain. It can be stated that defective porcelains are in general due to the accidents of manufacture, the dielectric strength of all the porcelains being passably good except for flaws.

Part III includes data on tests carried out mostly with the high-frequency outfit. An electrical method is shown of producing failure along invisible cleavage surfaces in the porcelain body. This examination should be useful to the porcelain manufacturer to indicate how nearly the porcelain is approaching to a weakness which will cause the rejection of the porcelain piece. Another method, using potential gradient to investigate the homogeneity of the porcelain, may be found of use in determining the efficiency of the pug mill which is used to mix the ingredients when the porcelain is in the early plastic stage.

A. O. Austin opened the discussion. He pointed out that electrical requirements have caused a marked change in the methods of manufacture of porcelain. Insulators have often failed at voltages less than those for which they were designed, indicating that perfect uniformity in the manufacture has not been attained. He then proceeded to discuss methods of testing, and illustrated this work with numerous lantern slides. He considered the oscillating transformer valuable in eliminating certain insulators which have given trouble in service after passing the ordinary tests. He thought, however, that high-frequency phenomena caused probably not more than 1 per cent of the trouble which occurs on a transmission line which has been supplied with good insulators. He referred to the importance of the time element in conducting tests. He did not consider it worth while to attempt to develop porcelain which would withstand more than 200 to 250 kilovolts per inch. The oscillator test set has several advantages, one of which is furnishing high voltages at a comparatively low cost. He did not consider a high ratio of breakdown to arc-over voltage desirable in all cases. For example, a ratio of 1.2 might be better than 2 in some cases.

Crosby Field-Frank referred to the ease of operation of the oscillation transformer and the certainty of the results. He said that in testing insulating bushings which had already passed a 60-cycle test, the rejections averaged about 6 per cent, varying in different cases from 0 to 17 per cent.

J. T. Lawson stated that the oscillator test set has been used by the Public Service Electric Company, in New Jersey, for testing insulators and weeding out the defective ones. Of insulators already in service, this test produced failures in about 1.6 per cent of the pin type, and 3.5 per cent of the disk type. Interruptions were reduced to 45 in 1914, as compared with 65 in the previous year. The lines of this company operate at 13,000 volts, 25 and 60 cycles. Lantern slides were shown of the line equipment previously in use, and of the new type of insulator which has been adopted and is now in service on 60 miles of line. In the case of one section of line which was changed over, and which previously experienced about one failure per week, there have been no failures since the change was made, all of the new type of insulators having first been tested by the oscillation transformer. The new type of insulator has a ratio of breakdown to arc-over voltage of about two.

Farley Osgood stated that this ratio might not be the best for lines operating at higher voltages, where the problems are quite different from those in the case of the Public Service Electric Company. He stated that testing with the oscillation transformer had proved very satisfactory.

L. L. Israel stated that the oscillation transformer had been used at the New York Navy Yard in testing insulators for wireless work. Dielectric hysteresis had been found to be of first importance in causing breakdown, whereas accidental flaws in the porelain had minor influence. The method followed was about the same as that given in the paper, but it was found that there was considerable dependence on the value of high frequency, as well as the spark frequency and the amount of damping. The damping in his case was probably lower than in the case of Professor Creighton's apparatus. He stated that all breakdowns were influenced by the heating effect, and the voltage necessary varied inversely with the time of application; this time also varied inversely with the number of wave-trains per second. He thought, consequently, that the conditions specified in the paper were not sufficiently definite, and the wave-train employed no doubt varied from time to time. He pointed out that the wave-form of the applied voltage would vary with the type of insulator tested, since the latter acts as a condenser in circuit with a reactance. The wave-form would also be affected by the spark-gap employed.

R. P. Jackson said that the Westinghouse Electric & Manufacturing Company had employed two different methods for the impact test: (1) that described by Professor Creighton, and (2) the method of charging and discharging an air condenser described in a former paper by Imlay and Thomas. The oscillation transformer was more portable and involved no danger, since the high voltage was generated at high frequency. Comparative tests have been carried out, which show that insulators puncture at the same voltage, as measured by a sphere gap, regardless of the frequency used. The principal advantage of the oscillation transformer is its convenience. When voltages are applied which cause corona without arcing, there are no more failures at high frequency than at low freqeuncy. The disadvantage of the oscillation transformer is that the number of insulators which break down depends upon the time of application. This would indicate that all insulators tested are damaged to some extent. This test should therefore not be used universally, but may be applied for a very short time to weed out the worst specimens. By continuing the application for a suitable period, either method may be made to give equal severity of test. He did not think the time was yet ripe for standardizing any method of test. He then referred to tests made by applying direct current to the low-voltage coil of a transformer, thus giving an impact test with a definite number of impacts. This test is just as severe as an alternating-current test, but eliminates the heating. Using the same voltage, it was found that flash-over occurs much more frequently when the pin is the negative electrode, regardless of which side of the circuit is grounded. When the electrical stress is repeated a number of times in the same direction, the porcelain withstands it better than when the direction is reversed with each application.

P. W. Sothman said that the high-

frequency test, while showing up weaknesses that would otherwise require time, would not make other forms of test unnecessary.

William Jacobi discussed the subject from the standpoint of the designer and producer of porcelain. He pointed out that the designer must first investigate his materials thoroughly, and that the manufacturer attempted to secure uniformity throughout the mass. It is difficult to do this, however, as vitrification cannot be accurately controlled, and strains will arise in the insulator in cooling. The point of breakdown is often one where there is an initial strain. Stresses may be caused, too, by differences of temperature due to electric discharges themselves. The manufacturer is always ready to do whatever is possible to meet any given conditions of service.

Julian C. Smith gave some results of tests on the high-tension line of the Shawinigan Water & Power Company, which has been using an old design of disk-type insulator for about three years. There were 37,800 suspension units and 9,000 strain units. Of the former, 10,800 were end units, and of the latter, 2,400. The entire number of failures has been 2.58 per cent; of the suspension units, 2.47 per cent; of the strain units, 2.79 per cent. The failure of end units has been greater than the average, amounting to 3.39 per cent; and more of these were at the line end than at the ground end. The group showing the greatest percentage were at the line end of the strain insulators, which showed 4.56 per cent. He considered that a large percentage of the failures, about half, were due to mechanical conditions, and were fairly evenly scattered over the line. The remainder were probably due to local conditions of voltage. He has used the high-frequency test, but has not found it of any particular benefit. Units of the earlier design, when subjected to a change in temperature, can usually be made to fail. This is probably due to the expansion of the cap. Newer designs behave better in this respect.

In closing the discussion, Professor Creighton pointed out that the problems which arise are different according to the conditions of operation, as, for instance, on a 13,000-volt transmission line, and in wireless installations. He reiterated that tests should be carried out under the conditions of actual operation, and what is suitable for one case is not the best for another. The principal difference between ordinary frequencies and frequencies over 100,000 cycles per second is that in the former case the discharge will jump through the air, whereas in the latter case it follows the surface of the insulator. After he exhibited some samples of punctured porcelain, the convention adjourned.

On Thursday afternoon an inspection trip was taken to the power house of the United Electric Light & Power Company, at 201st Street.

On Thursday evening a dinner-dance was held at the Hotel Astor, where covers were laid for 350. The only incident to mar this event was the sudden death of H. Ward Leonard, who was stricken at the dinner table, and although able to walk from the room, expired later in the evening, unknown to the other guests, except a few intimates who were quietly informed. An obituary notice of Mr. Leonard will be found on page 406.

Western Society of Engineers Upholds Status of Engineering Report.

At a meeting of the Western Society of Engineers, held in Chicago, on February 1, important resolutions were passed bearing on the right of engineers to submit reports based on facts and unbiased by any other interest. The occasion arose from the criticism directed against the members of the Commission on Sewage Disposal and Water-Power Development, who recently submitted a report on the hydroelectric development of the Sanitary District of Chicago, which was abstracted in the ELECTRICAL REVIEW AND WESTERN ELECTRICIAN of December 5, 1914. The report has been signed by L. E. Cooley, L. K. Sherman, John Ericson and William Artingstall. The two latter are in the engineering service of the city of Chicago. Members of the City Council, other city officials and the local newspapers criticised them for recommending an increase in rates paid by the city to the Sanitary District for electric service.

The main part of the resolutions adopted by the Western Society of Engineers follows:

Whereas, Certain members of the Sanitary District, the City Council of Chicago, and the daily press have poured out a torrent of fretful rebuke and personal insinuation against the individual members of the Commission, all apparently because the facts and conclusions of said report were not what had been expected; and

Whereas, Among the members of this Society signing the report were Lyman E. Cooley, John Ericson, L. K. Sherman, and William Artingstall, all engineers of reputation, experience, and good standing in the community, who have devoted the most of their professional lives to the service of the public;

Therefore Be It Resolved, That this Society views with regret this public attempt to abuse men who were apparently trying to do their duty to the public in setting forth facts as they found them and testifying to the truth as they saw it, and the Society would point out for the benefit of the public officials, who have been conspicuous in this controversy, the following proper relations with engineering advisers, which it wishes to emphasize at this time, as a matter which vitally affects the public welfare:

First. That an engineer's first duty to his client is to tell him the truth, no matter where it may lead, or how unpalatable it may be.

Second. That engineering and engineering economics are subject to natural law, which cannot be altered to suit the whims of human nature.

Third. That the most serious disgrace that comes to an engineer is to conceal, pervert, or distort natural and economic law, either to please a client or temporarily advance his own interests, and so ultimately lead his client into difficulties.

Fourth. That an experienced engineer of standing ranks as a confidential professional adviser, feeling keenly his responsibilities, and whose integrity and conscientiousness, when properly established, should be appreciated and upheld by his client.

Fifth. That engineers, while not infallible or superhuman, are more apt than laymen to be right in their findings on engineering facts and economic truth connected with engineering matters. And

Be It Further Resolved, That while the Constitution of the Western Society of Engineers provides that the Society "Shall neither endorse nor recommend any individual or any scientific or engineering production," it does provide that the opinion of the Society may be expressed on "Such subjects as affect the public welfare," and it is the desire of the Society, by this resolution, to point out that the public welfare is vitally affected by any pronounced attempt on the part of public officials to suppress, conceal, distort, or overawe, the carefully prepared opinions of experienced engineers, reporting on public questions for the public interest.

The Society would further point out that if the findings of an engineering report are open to question, there are a number of proper and dignified procedures that can be adopted to check its conclusions.

These resolutions were submitted to the city Council on February 17 and placed on file.

Lynn Section, American Institute.

At the meeting held by the Lynn (Mass.) Section of the American Institute of Electrical Engineers, on February 17, J. L. Woodbridge delivered an instructive lecture on "The Characteristics and Uses of Storage Batteries." The meeting was largely attended. By means of lantern slides and special apparatus the general subject was well elucidated. The numerous uses to which batteries are put for operating trucks, boat lighting, propelling submarines, and the maintenance of power-station service for overloads and emergencies were carefully gone into. A map of Germany was shown, and the wonderful network of electric railways operated by storage batteries was described.

Vehicle Maintenance Discussed at Chicago Meeting.

In an address before the Chicago Section, Electric Vehicle Association of America, on February 23, R. Macrae, vehicle engineer of the Commonwealth Edison Company, presented some interesting data on the methods and cost of commercial electric vehicle operation. Mr. Macrae held that operating methods have not kept pace with the developments in the vehicles or batteries and accessories. The failures of electric vehicles, especially in the commercial field, are in practically all cases due to faults in operation or in methods of maintaining the vehicles. He cited instances showing that much of the trouble encountered with electrics is due entirely to neglect or ignorance in caring for the car and these experiences tend to retard the proper development of the industry.

Mr. Macrae presented statistics on the operating cost of several commercial vehicles that are giving satisfactory service, although the vehicles themselves are of inadequate design and operating under adverse conditions. One vehicle referred to, a 1,000-pound type, operates only about four or five hours per day, and covers a distance ranging from eight to fifteen miles. This rig is used for towel delivery and the driver devotes a part of his time to other duties. The average kilowatt-hour consumption per month for this vehicle is 149, the batteries being charged every second day. The average cost of current per month is $7.45, and the storage charges are $18.00 per month, making a total monthly operating cost, exclusive of driver's salary, of $25.45. This vehicle represents a first cost of only $500, and was purchased second-hand. It is equipped with a 32-cell Philadelphia thin-plate battery.

Another vehicle referred to was a two-ton truck for delivering fish. This vehicle averaged 500 miles per month, the energy consumption being 452 kilowatt-hours. The cost of operation per month for this car averaged $44.60.

A 3,000-pound parcel delivery wagon, commented upon, covered an average mileage of 1,226 per month, the energy consumption averaging 795 kilowatt-hours. In this case the cost of energy averaged $39.70 per month, while the garage charge is $25.00 per month. The vehicle is equipped with 60 cells of Edison A-6 battery.

Mr. Macrae called attention to a report which has been submitted to the City Council of Chicago by the Efficiency Committee of the Civil Service Commission covering garbage haulage, in which a table of comparative electric vehicle and horse-drawn costs are presented. According to this table, the cost of operating an electric vehicle is shown to be proportional to the mileage covered. For the short hauls, these figures showed the horse-drawn equipment to be much more economical than the electric, while for long hauls the electric was shown to be cheaper. Mr. Macrae pointed out that the conclusions drawn in this report were entirely erroneous, and he presented data showing the cost of delivery by means of electric vehicles for short hauls to be much lower than the cost for horse-drawn wagons doing the same work. He thought that some effort should be made to provide the Council with proper data on the subject.

In conclusion, he made a plea for a greater standardization in battery equipment, urging that the large number of batteries containing various numbers of cells be eliminated to a few standard-size batteries. This would greatly simplify garage practice and insure vehicles receiving better care.

Mechanical and Electrical Features of the Panama Canal.

The above was the subject of a very interesting illustrated talk by Edward Schildhauer, mechanical and electrical engineer for the Panama Canal, at a meeting held in Chicago on the evening of February 23. This was a joint meeting of the Electrical Section of the Western Society of Engineers and the Chicago Section of the American Institute of Electrical Engineers.

Mr. Schildhauer touched on a very wide range of topics, beginning with the general nature of the Canal Zone, and then taking up some of the construction features. The Gatun hydroelectric plant was described, also the equipment of the substations, and of the transmission towers, over which power is transmitted along the line of the Panama Railroad. The operation of the locks was described in detail, and the method of towing vessels through the locks was also explained. A very large number of slides showing various stages in the construction of the canal were shown. The operation of the locks was also made clear by many views. Two reels of motion pictures, kindly loaned by the General Electric Company, were displayed, showing construction views, particularly in the Culebra cut, and also operation of the lock control boards and of the actual manipulation of the gates, valves and other lock machinery. The operation of opening and closing the lock gates and filling and emptying the lock chambers was very strikingly displayed in this manner.

Among the points brought out by Mr. Schildhauer were the early adoption of 25-cycle, three-phase current for the operation of all of the electrical equipment. Although at the time this was decided on some fear was felt that it might detract from the effectiveness of illumination, it was desired, however, to simplify the electrical equipment as much as possible. The improved lamps used have shown no difficulty from the low frequency. Direct-current motors were not used in any case, because of the difficulties in commutation and the excessive moisture prevailing on the isthmus, which is particularly injurious to the commutators of machines. Practically all motors are 220-volt, three-phase, squirrel-cage induction machines. It is planned to install two additional hydroelectric plants so as to utilize the water power available to the best advantage, instead of increasing the equipment in the present Gatun plant. Mr. Schildhauer said that although electrification of the Panama Railroad was thought of, this has not yet been decided on, because the amount of traffic this railroad will have in normal operation is not yet definitely known. However, it was his private opinion that it would be desirable for this railroad to be developed along the lines of our interurban electric railways, giving frequent high-speed service from one end of the Canal Zone to the other. During construction, this was impossible, because of impeding of traffic by the large number of construction trains that had to be given right of way. In most of the designing of the mechanical and electrical equipment of the canal, the engineers had very little data available, and had to depend on estimated requirements to a very large extent. The Panama Canal engineers feel very gratified that the canal has been operated even more successfully than was anticipated, this being particularly true of the operation of the locks.

Missouri Jobbers Organize.

A meeting of the Missouri River Club, an organization of electrical jobbers from Omaha, Neb., St. Joseph, Kansas City, and Lincoln, was held at Omaha, on Friday, February 18. Officers were elected for 1915. G. W. Johnson, of the Midwest Electric Company, of Omaha, was made president, and Harry Goodell, of the Western Electric Company, in Omaha, secretary. The retiring president is W. R. Thomas, of St. Joseph, and J. M. Bateman, Omaha, retires as secretary. Franklin Overbagh, secretary of the Electrical Supply Jobbers' Association, and N. D. Harvey, of Chicago, attended as guests of the club. Thirteen jobbers from Missouri, Kansas and Nebraska were present. A discussion of the year's outlook for electrical jobbing disclosed general optimism.

New Electrical and Mechanical Appliances

Hubbell Duplex Wall Receptacle.

It has long been felt by electrical men who have given the matter careful study that the objectionable practice of using fixture outlets for attaching all kinds of electrical devices, many of which take fully 600 watts, would be eliminated if the public were encouraged to use special wall outlets for this purpose. It has been difficult, however, to educate builders and architects to the desirability of providing liberally in the way of wall receptacles and in but few buildings does one find a plentiful supply of such facilities.

This situation has been ingeniously met by the development of a duplex flush receptacle which provides two separate outlets from a single wall box, thus greatly increasing the utility of the installation at very small additional expense compared to the cost of a regular two-gang outfit. The two outlets are connected to a single heavy porcelain body and but one set of binding screws needs to be connected to the circuit. The contacts are of liberal size and each outlet is rated at 6 amperes, 250 volts. The entrance slots are of T section and increase the utility of the plug. Some 17 different styles of Hubbell knife-blade-contact plugs can be used with these receptacles. Although slightly longer than the standard Hubbell flush receptacle, the new duplex receptacle fits into most single-gang switch boxes.

Hubbell Duplex Receptacle.

These receptacles are finished in nine standard finishes as to the face plate. The porcelain center is usually black, except for hospitals, bath rooms, etc., where white centers are supplied. Installation of these receptacles encourages the liberal and proper use of all electrical appliances in offices, residences, schools, libraries, etc. A very large number of them have been installed in the new mammoth Equitable Building in New York City.

These fittings are manufactured by Harvey Hubbell, Incorporated, Bridgeport, Conn.

Boron - Aluminum - Silicate Insulators.

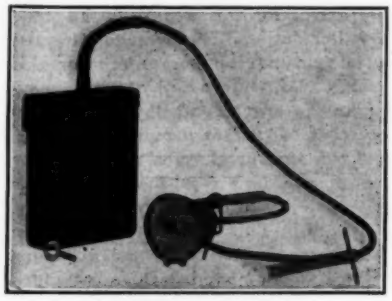
Patents were issued to Fred M. Locke, Victor, N. Y., on February 2, for boron-aluminum-silicate and boron-silicate insulators. The accompanying illustration shows the form in which the insulators are at present being produced. Mr. Locke claims that these insulators meet all requirements for extra-high-tension work, and show remarkable performance characteristics for high-frequency service up to 500,000 cycles. The insulators are especially designed for high specific inductive capacity, high dielectric and mechanical strength, and they will be developed in several styles for high-voltage transmission lines, for condenser work, condenser terminals, bushings, and also in special shapes.

New Locke Suspension Insulator.

New Type of Miner's Electric Lamp.

The General Electric Company is offering a new miner's electric lamp that is believed to be entirely safe to use, of very strong construction yet light in weight, simple in design, foolproof, very efficient in operation, and of ample guaranteed capacity. The outfit consists essentially of a lead-plate storage battery carried on the belt; a three-quarter-candlepower Mazda lamp with a suitable reflector held in a steel shell, carried on the cap; and a strong, serviceable cable connecting the battery and the lamp.

Owing to the hazardous nature of work in gaseous mines, a demand has been growing for some time for a practical, portable electric lamp. That an electric lamp would be safe to use has been well recognized, because it could be made so that it would not ignite inflammable gases and would produce a uniform light regardless of atmospheric conditions. As long as the carbon-filament lamp represented the best available electric illuminant, such a miner's lamp was not possible, because of the relative inefficiency of the lamp and because storage batteries of the required capacity could not be designed within permissible weight and dimension limits. The perfection of the efficient Mazda tungsten lamp in miniature sizes and the development of small, efficient, light-weight storage batteries has resulted in the design of the new miner's electric lamp known as type BL, form B.



Miner's Electric Lamp.

The prime feature of this lamp is that it has been made thoroughly safe to use. By adequate insulation of the entire circuit, placing all the terminals and contacts inside of locked and sealed steel cases, and providing automatic means for extinguishing instantly the glow of the filament, should breakage of the lamp bulb expose it to the air, this lamp, which is built of high-grade materials, has been made both safe and rugged. The outfit com-

plete weighs but 3.75 pounds, of which 3.5 pounds are carried on the belt and 4 ounces on the cap. The battery is rated at 7.2 ampere-hours. Normally it will light the lamp 12 hours per charge and can be relied on to furnish light at least 10.75 hours per charge at the end of one year's service. The three-quarter-candlepower Mazda lamp operates at 1.9 volts and the reflector distributes the light evenly through a solid angle of about 130 degrees.

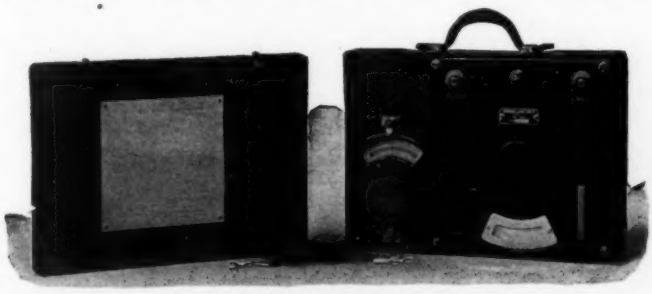
The battery is non-spilling and the terminals are not subject to acid corrosion. The case is of medium hard rubber. Exide plates are used. The battery box measures 6.25 inches high by 5 inches wide by 2 inches thick over all. It is made of drawn sheet steel, electrically welded, including the two side straps for the miner's belt. After welding, the box is lead-plated and painted with acidproof paint. The cover is drawn steel, hinged at one end and fitted with a substantial lock at the other end. The terminal contact block is riveted to the inside of the cover. Connection to the battery terminals is made by strong spring contacts, arranged to close the circuit when the cover is shut. The cable entrance bushing is water-tight and clamps the cable firmly to prevent strain on the terminals.

The lamp bulb, reflector and terminal contact block are incased in a light, strong, drawn-steel shell, which is copper-oxidized, enameled and provided with a hook for attaching to the miner's cap. The entrance bushing leads the cable through the back of the shell where it is reinforced by a steel plate. On the terminal contact block, which is waterproof and screwed to the protecting shell, are mounted suitable terminals for cable connections and the spring contacts which hold the lamp bulb. The contacts are nickel-plated. The reflector is of drawn steel, white porcelain-enameled. A rubber gasket between this and the glass renders the case waterproof. The glass is held by a phosphor-bronze retaining ring, which has its ends looped and flattened to extend through slots in the rim of the case for a seal wire.

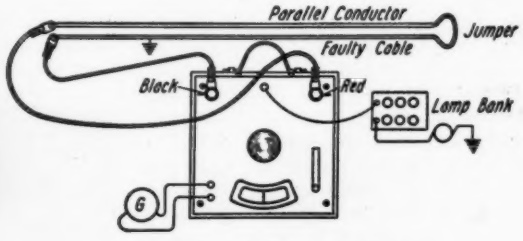
The Mazda lamp bulb has its filament inserted and connected with a base contact in the usual manner, and at the tip of the bulb is a duplicate contact to which the filament is connected by a fine copper wire along the outside of the glass. The bulb is held at the focal point between the contact springs, which maintain it constantly under stress, so that, in case of a blow otherwise only sufficient to chip or partly break the bulb, it will be completely shattered by the springs and will drop clear of the contacts. Sufficient space is provided between the reflector and glass cover to keep broken lamp parts from short-circuiting the spring contacts. This prevents the possibility of ignition, even if the cap lamp is seriously damaged amid explosive gases.

The cable consists of two braided-strand, rubber-covered conductors, each having a steel piano wire at the center. These are twisted together and then heavily rubber-covered, making the cable strong, well insulated and not liable to kink. The ends are protected from wear and damage by flexible steel armor. To meet practice analogous to that of flame lamps, this electric lamp is designed to be supplied to miners from the lamp house. The outfits are to be assembled and locked with the lamps burning when delivered, and are to be returned to the lamp house in the same condition at the end of the shift. No care or attention whatever is required from the miners.

Of course, direct current only must be used for battery charging. In some instances mercury-arc rectifier or motor-generator sets may be required to change alternating current into suitable direct current. Small sets adapted for this purpose can be supplied readily. Charging racks arranged for charging batteries conveniently in quantities are also offered.



Westinghouse Portable Fault Localizer.



Test Circuit Using Localizer.

Westinghouse Portable Fault Localizer.

A portable fault localizer, for quickly locating a ground on a power cable is now being marketed by the Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa. The position of a ground is read directly off the dial in terms of per cent of length of defective cable. It is an application of the Wheatstone bridge with all the necessary apparatus contained in one portable case wired for connection to the circuit to be tested. Its use assumes that the cable is grounded at only one point and that a parallel conductor of the same length and resistance as the faulty cable is available.

After proper connections are made, a dial on the instrument is revolved by means of a knob in the middle of the localizer until the galvanometer shows no deflection when the key is closed. The reading of the meter then gives the percentage of length of the feeder from the point where the test is being made to the location of the ground, assuming the total length of the feeder to be 100 per cent; the red scale indicates that the ground is on the conductor connected to the binding-post marked red, and the black scale indicates to the binding-post marked black. Direct current only is used in these tests.

The fault localizer consists of a polished wooden case which contains all the parts necessary for the test except the source of direct-current supply and the leads to the cables. Two styles are furnished, one containing a galvanometer and the other for use with a separate galvanometer.

The variable-resistance arms consist of two loops of low-resistance wire attached to the side of a revolving disk, upon which the dial is attached, so that contact is easily made from two brushes attached to the case and connected to the galvanometer terminals. As the disk is revolved the point of contact between the brushes and the resistance loops is thus varied, as in the slide-wire bridge. The dial is calibrated in percentage of the length of the conductor tested, so that the reading is direct.

The galvanometer is highly sensitive, having a "uni-pivot" bearing which does not have to be leveled to take readings. It can be used for general testing wherever a portable galvanometer of its sensibility is desirable,

and can easily be removed from the case when this is desired. It has a resistance of 5 ohms, a full-scale reading of 0.00,036 ampere, and sensibility of 0.00,001 ampere per division.

Fifteen-Thousand-Volt Submarine Cable at Portsmouth, N. H.

The Simplex Wire & Cable Company, Boston, Mass., has been awarded the contract to manufacture and lay about one mile of three-conductor, cambric-insulated, submarine cable for the Rockingham County Light & Power Company, of Portsmouth, N. H. The cable is to be laid across Great Bay, above Portsmouth, early in the spring and will form a part of the transmismission line from the central station at Portsmouth, through the towns of Newington, Durham and Madbury to Dover, where current is supplied for the Dover, Somersworth & Rochester Street Railway. At Durham a branch line supplies light and power to New Hampshire College. Each conductor is to be No. 4 B. & S. stranded copper and will have varnished-cambric insulation seven-thirty-second inch thick. A jacket of varnished cambric six-thirty-second inch thick will be applied over the three insulated conductors after they are twisted together. The cable is to be protected by a lead sheath one-eighth inch thick and an armor of No. 6 B. W. G. galvanized-steel wire, and will weigh about twelve pounds per foot. It will be sent from Boston to Portsmouth on a lighter, the gross shipping weight being about 65,000 pounds. The T. A. Scott Company, of Boston, marine contractor and wrecker, will supply the lighter and apparatus to be used by the Simplex Wire & Cable Company on this work.

Interesting Application of Electric Power in a Lumber Yard.

In the lumber yard of the Church E. Gates Company, New York City, electricity unloads, conveys and sorts the lumber. This yard is located on the East River, the lumber being brought in by boats which dock on either side of a slip built for this purpose. Fig. 1 shows the approximate layout. At either side of the slip into which the boats come, there is a conveyor which carries the lumber taken from the boats to the end of the slip where it is passed over to the two main conveyors that are 600 feet long.

The two smaller conveyors at the docks are each driven by 12-horsepower, 220-volt, three-phase motors of the slip-ring type. The long conveyors are driven by 20-horsepower motors of the same type; Fig. 2 shows one of these motors and the method of driving. These are automatically controlled by Cutler-Hammer remote-control starters. The method of operating the conveyor is by means of an endless-chain arrangement, which drives a series of rollers spaced about ten feet apart. The driving chain and the rollers can be seen in Fig. 3.

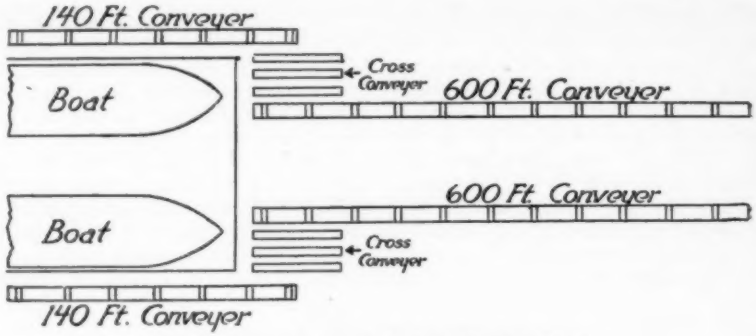


Fig. 1.—Conveyor Layout in Gates Lumber Yard.

What is of particular interest is the method of throwing the lumber out into the yard streets at various points so that the electric hoists can pick it up and place it on the proper pile. To accomplish this, magnetically operated remote-controlled deflecters are used, the solenoids being furnished by the Cutler-Hammer Manufacturing Company, Milwaukee, Wis. The deflecters are placed on the main conveyors at intervals of about 60 feet, two being shown in Fig. 3. The deflecter in the foreground is open, that is, lumber may pass by without interference. The next deflecter, however, is closed and lumber traveling on the conveyor is deflected onto the street until the operator allows the deflecter to open. These deflecters are operated by an attendant located so as to get a view of the conveyors and can thus close or open any deflecter desired. A solenoid at each deflecter does the work of closing or opening, depending on whether it is energized or de-ener-

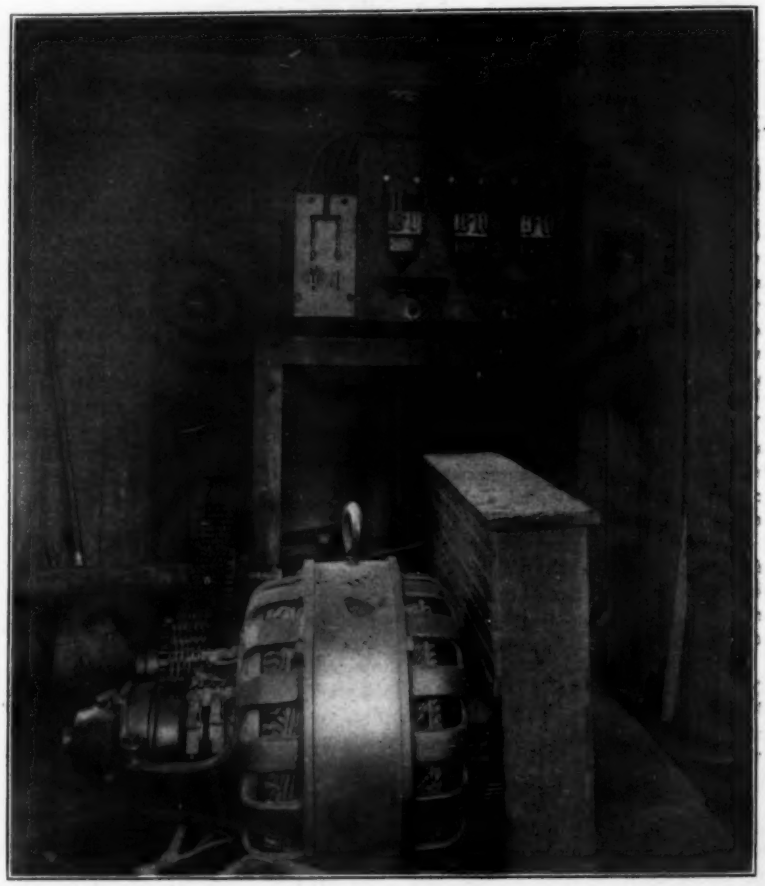


Fig. 2.—20-Horsepower Induction Motor With Control Panel for Driving One of the 600-Foot Conveyors.

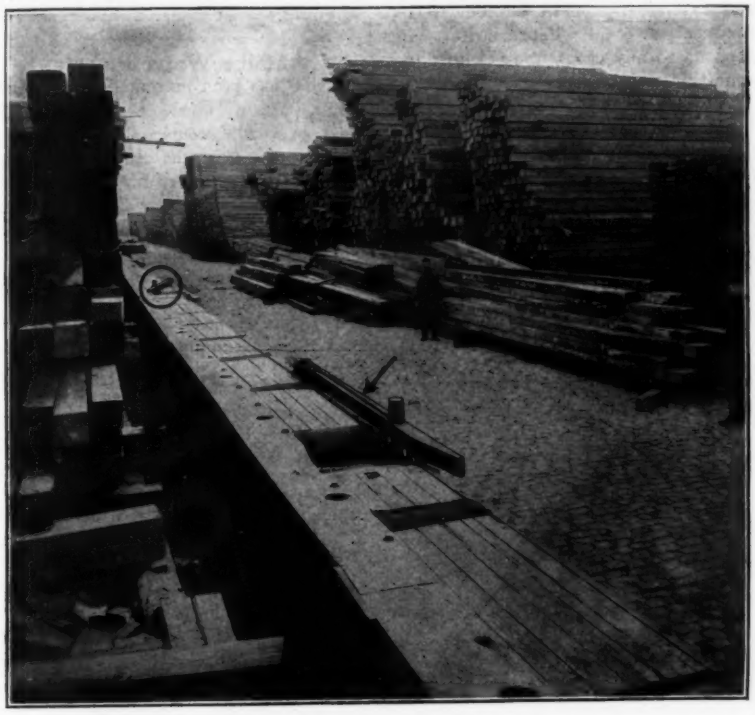


Fig. 3.—Electrically Driven Conveyor, Showing Driving Chains and Deflectors.

gized. To close the deflector the attendant simply throws in a switch in the solenoid circuit of that deflecter. This allows the deflecter to move over and set at an angle, as illustrated in Fig. 3.

The lumber is unloaded from the boats by means of electric hoists and is also picked up from the street where it is thrown by the deflecters and carried to the lumber piles. Several of the hoists are shown in Fig. 4.

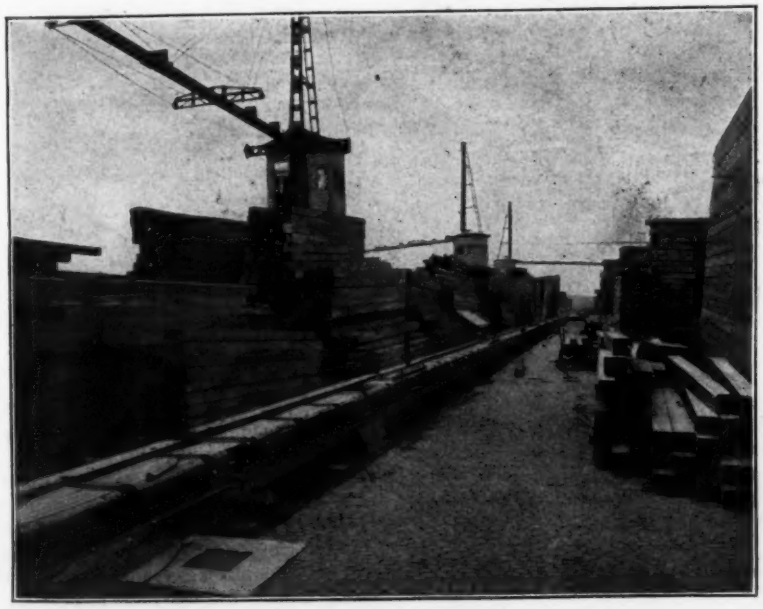


Fig. 4.—One of the 600-Foot Conveyors and Several of the Electric Hoists.

Pennsylvania Engineers Inspect New Large Interborough Turbo-generator Units.

The East Pittsburgh shop of the Westinghouse Machine Company was the point of interest for the Engineers Society of Western Pennsylvania on the afternoon of February 20, when about 200 members went on a trip of inspection to see the mammoth steam turbine just completed by the Westinghouse Company. The machine has a rating of 30,000 kilowatts, and will be installed in the Seventy-fourth Street power station of the Interborough Rapid Transit Company, of New York City.

An interesting point in connection with the development of this type of engine is gained from a comparison with large reciprocating steam engines which the turbines will replace. Four of these reciprocating engines, having a total capacity of 28,000 kilowatts, are being removed and replaced by three turbine units, with a total capacity of 90,000 kilowatts, and the turbines occupy less space with this greatly increased capacity than the reciprocating engines. The capacity of this portion of the power house will be increased 220 per cent without increasing the size of the building.

In view of the high price of real estate in New York this is of very great importance. Advantage, however, is not confined to space economy, but also high efficiency is obtained. The turbines are said to have the highest efficiency ever guaranteed by a manufacturer.

The original order called for three turbines, and two of them were installed in New York last December. The form of construction is decidedly novel, in that the electric generator to be driven by the turbines is composed of two separate units, which operate together in parallel. The turbine unit complete weighs 1,560,000 pounds, and the copper in the blades of the turbine alone weighs 38,400 pounds.

National Carbon Company Has Good Year.

Profits of the National Carbon Company for the fiscal year ended December 31, 1914, were equal to 26 per cent on the common stock, as against 15 per cent the previous year. The annual report issued yesterday made the following exhibit:

	Dec. 31, 1914	Dec. 31, 1913
INCOME ACCOUNT.		
Profit	$ 2,215,880	$ 1,476,621
Depreciation	389,872	329,690
Accts. written off	19,708	6,024
Div. on pfd. stock	372,750	315,000
Div. on com. stock	582,930	330,000
Employee bonus	25,000	.....
Surplus	825,618	495,907
BALANCE SHEET—ASSETS.		
Real estate, plants	11,372,706	8,540,132
Merchandise	3,137,874	1,556,546
Cash	1,074,852	638,611
Cash res. for divs.	149,482	82,500
Notes & accts. rvble.	1,612,969	860,304
Prepaid exp.	23,342	17,028
	$17,371,228	$11,695,121
LIABILITIES.		
Pfd. stock	$ 5,600,000	$ 4,500,000
Com. stock	9,965,500	5,500,000
Accts. payable	425,389	232,385
*Div. sec. payable	149,482	82,500
Insur. reserve	50,000	50,000
Reserve empl. bonus.	25,000	.....
Profit and loss acct.	1,155,856	1,330,236
	$17,371,228	$11,695,121

*Common dividend payable.

In his report to the stockholders President James Parmelee said:

"I am pleased to state that, notwithstanding the business depression during a large portion of the year, the company was able, in view of its diversified products, to make quite a satisfactory showing.

"In February last the property and business of the American Ever Ready Company of New York and San Francisco were purchased, the transfer taking effect as of January 1, 1914, and those plants have since been operated as branches of the National Carbon Company, and the financial report of course includes the business of those plants.

"The company now has 10 factories in operation, and also a factory in Toronto, Canada, operated under the name of the Canadian National Carbon Company, Limited. During the last year the National Carbon Company completed its new factory in Jersey City, N. J. The company is also completing a large new factory in Long Island City.

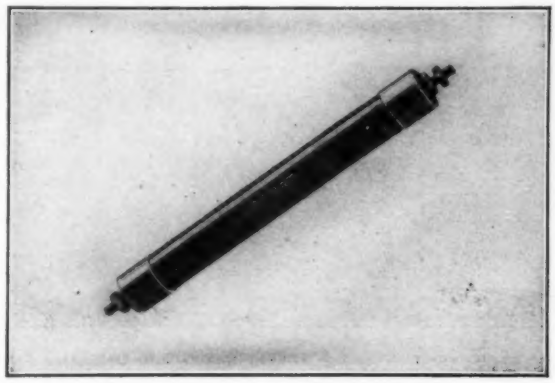
"Under the authority of a resolution adopted by the stockholders at their meeting on February 16, 1914, the executive committee offered to the company's employees the 5,000 shares of common capital stock set aside for that purpose. The plan of distribution provides that faithful employees are entitled to subscribe for the stock at par, and that they shall be given from three to five years in which to complete their payments. Interest is charged on all unpaid amounts, and dividends are credited toward principal at the same rate which is paid to other holders of common stock. A bonus of $5 per share per year will be credited to the accounts of employees who are subscribers, for faithful and continuous service during the five years over which the profit-sharing plan extends. Subscriptions have been accepted from 1,264 employees."

Koppat—A New Waterproof Resistance Material.

A new resistance, known as "Koppat," is being placed on the market by the Railway & Industrial Engineering Company, Greensburg, Pa. It is a vitreous composition material which can be made in various shapes and dimensions and has a resistance to meet most commercial requirements. Its electrical and physical properties both combine to make it best suited to meet the requirements for which wire-wound resistance is now generally used.

Koppat conducts current uniformly throughout its entire mass, is strong mechanically, and has a low temperature-coefficient of resistance. It will not oxidize, nor is it subject to any chemical or other depreciation when exposed to any climatic or atmospheric condition.

The resistance was originally developed for use in connection with the Burke horn-gap lightning arrester. This service called for a resistance that was weatherproof in every respect and one capable of withstanding momentarily extremely heavy current and attending strains. For some time it has been giving most excellent results on this work to which no other resistance proved so well fitted.



Koppat Resistance Element.

Koppat has proved so satisfactory in connection with various classes of lightning-arrester work that it is being placed on the market for other commercial needs, such as switchboard work, rheostat service, storage-battery charging, and as permanent or limiting resistance to be used with arc headlights, signals, etc., and in the form of resistance units mounted on brackets for various services.

The manufacturers express their willingness to send samples to interested parties who will state their requirements and the service for which they may wish to use such a resistance.

Maine Water Powers.

A bill has been presented in the Maine Legislature to create a Commission to take over all occupied and unoccupied water powers in the State, to develop, sell, and lease powers for a term not exceeding 10 years. Provision is made to recompense abutters.

The Commission is given authority to ascertain the location and extent of the water powers.

The bill proposes to limit the rental price to a minimum of $20 and a maximum of $50 per horsepower per year. A provision is made to allow a company to lease and improve unoccupied powers, with the privilege of renewal of lease after first expiration.

Walpole Tire & Rubber Company Receivership Soon to Be Terminated.

Pursuant to a court order, the property, in one lot, of the Walpole Tire & Rubber Company, Walpole, Mass., will be offered at a receiver's sale to be held at Walpole on March 10, 1915. Complying with this legal requirement will amount to a virtual termination of the receivership.

Plant of the Walpole Rubber & Tire Company.

Receivers were appointed August 2, 1913, following financial troubles encountered through the collapse and failure of the Atlantic National Bank of Providence, R. I. No cessation of business had to be contended with, nor was the factory output impaired in any way. A handsome profit was shown every month, despite the business depression of the last half of 1914.

Current Electrical News

ATLANTIC STATES.

AUGUSTA, ME.—A contract has been made with the Central Maine Power Company, by which the present arc street lamps will be replaced by 600-candlepower nitrogen-filled incandescents, and the existing 60-candlepower incandescent units in round translucent balls will be replaced by 250-candlepower high-efficiency lamps.

RANGELEY, ME.—Articles of incorporation for the Oquossoc Light & Power Company, with a capital stock of $50,000, have been asked for, the company to operate here and in neighboring towns.

WATERVILLE, ME.—A municipal light plant, to furnish street and public-building lighting, but not commercial service, is the subject of a bill before the legislature. It seeks authority to utilize surplus water of the Kennebec Water District on Messalouskee Stream. W.

SHELBURNE FALLS, MASS.—Thirty-two-candlepower lamps on all streets except Bridge Street will be changed to 60-candlepower units, giving 87 per cent more light, the cost of the town being only about 50 per cent more. W.

WESTFIELD, MASS.—The annual report of the municipal lighting plant suggests the construction of a hydroelectric plant at the storage reservoir in Granville, Mass., where about 200 horsepower are available. W.

BRIDGEPORT, CONN.—The United Illuminating Company is adding a building 150 by 50 feet to its generating station on Pequonnock River. Two generators, of between 6,000 and 8,000 kilowatts, will be installed. W.

PERRY, N. Y.—The Perry Electric Light Company and the Warsaw Gas and Electric Company are considering the advisability of connecting the two plants with a power line so that a better efficiency can be maintained in the operation. It would also enable the farmers living along the highways between the towns to have the electric service in their buildings.

WILMINGTON, N. C.—Councilman Wood has had the city attorney draft a bill which has been sent to the county's representatives in the legislature, providing for an election at the time of the regular municipal election in May on the question of a municipally owned electric lighting plant. The bill will carry with it authority for a bond issue of $100,000 with which to install the plant.

NORTH CENTRAL STATES.

CADIZ, O.—Repairs to the amount of $12,000 will be made to put the Cadiz Electric Light & Power Company plant into service again. It was partially destroyed by fire on February 12.

CINCINNATI, O.—Charles A. Aull has secured the contract for the electrical work involved in the addition to St. William's Catholic school, in Price Hill, from Architects Joseph G. Steinkamp & Brother.

FORT LORAINE, O.—The Fort Loraine Light & Power Company has been incorporated for $10,000 by W. J. Sherman, Francis M. Sherman, B. T. Bull, H. E. Bennet and John Oldham.

IRONTON, O.—The Standard Slag Crusher Company will install at the plant of the Marting Iron and Steel Company a slag-crushing plant, to be operated by electricity. The Ohio Valley Electric Company will furnish current. L.

NORWALK, O.—The bonds for the construction of a municipal lighting plant have been purchased by Stacy & Braun, of Toledo, and the employment of an engineer to prepare plans for the erection of the plant and the awarding of contracts for machinery and construction will be taken up by the City Council. The issue is for $100,000.

RIPLEY, O.—Electric light bonds to the amount of $12,000 have been disposed of, and the town will shortly let contracts for the construction of an electric plant with the proceeds. L.

VINCENNES, IND.—Cluster lights on iron standards are to replace the wooden poles and arc lights on Main Street, according to a plan agreed on by the city and R. S. Stangland, representing the city lighting company.

BROOKSTON, MINN.—The village council has passed an ordinance authorizing L. P. Runkle to erect and maintain electric light poles in Brookston.

HENDRUM, MINN.—One of the steps which this town is likely to take in the near future is the construction of a dam at Rice Lake, and the installation of a power and lighting system.

MINNEAPOLIS, MINN.—Edward P. Burch, consulting electrical engineer of this city, has completed specifications for the pumping equipment of the municipal power plant which is to be erected at Grand Rapids, Minn. The electrical equipment will consist of two 40-horsepower, 2,200-volt, three-phase motors for driving two pumps; capacity, 750 gallons per minute each. B. I. Pratt, secretary of the light and power commission, Grand Rapids, will receive bids until March 10.

SPRINGFIELD, MINN.—A movement is under way for the construction of an electric light and power plant to serve the needs of this village.

WINDOM, MINN.—Plans and specifications have been issued for an electric light plant for this village. The principal equipment will consist of one 75-kilovolt-ampere and one 100-kilovolt-ampere engine - generator unit, switchboards and accessories, poles, wires, street lamps, and transformers for the distribution of light and power to the village. Earle D. Jackson, St. Paul, is consulting engineer. Bids will be received by the village recorder until March 16.

CARPIO, N. D.—A petition calling for an election to vote on bonding the village for $2,500 for the establishment of an electric light plant in Carpio has been circulated and apparently is receiving a liberal endorsement at the hands of signers.

MILNOR, N. D.—David Vail, of Milnor, has asked the council of this place for a franchise to install an electric light plant during the coming summer. Mr. Vail asks for a 20-year franchise, but it is understood while this will be granted the city maintains the right to take over the plant at any time it may be financially able to do so. Mr. Vail was notified to file plans and specifications. A 24-hour service will be furnished or none at all and a "white way" may also be provided for.

EDGAR, NEB.—The city council at its last meeting favored the ordinance which calls for a special election March 4, to vote on the issuing of bonds for $13,500, for the purpose of building a new electric light building and purchasing new dynamos, engines and other necessary equipment.

HALE, MO.—Engineers W. L. Rollins & Company, Midland Building, Kansas City, Mo., are preparing plans for an electric light plant to cost $11,000.

INDEPENDENCE, MO.—The City of Independence has been asked by the residents of the Lexington Road district, about one mile east, to extend the city electric light lines to that vicinity. The matter has been taken under advisement. M.

SPRINGFIELD, MO.—The Springfield City Water Company is about to install electric pumping machinery and power at the new deep wells sunk by the company at the instance of the Public Service Commission of Missouri, after an investigation of the water supply of the city. Address R. L. Pate, manager. M.

CHAPMAN, KANS.—Two hundred persons at a meeting called by the city council recently, voted for the council to call a special election to vote bonds for a municipal light plant. There was only one vote against the proposition. Chapman already has an excellent water system.

OSSAWATOMIE, KANS.—A date will be set this week for the offering of bids for rebuilding and improving the light and water plant at Ossawatomie, for the city. Address city clerk.

SOUTH CENTRAL STATES.

BARDWELL, KY.—The city council is negotiating with Biehon & Reddick on the proposition of leasing the lighting plant and water system.

IRVINE, KY.—A franchise has been awarded to John W. Walker, of Corbin, to install an electric light and ice-manufacturing plant at Irvine. Local capitalists were contending bidders for the franchise.

SMITHS GROVE, KY.—The Town Board has contracted with Gill Edward,

of Pembroke, to install and maintain an electric light plant here, to be in operation by May 1.

WHITESBURG, KY.—The electric light plant at Hazard, Perry County, which went into the hands of a receiver several weeks ago, is being re-organized and put into working order again by the citizens of the town having organized a stock company to take over the plant. The progressive people of the growing city of Hazard saw that they could not do without the modern convenience of lights and immediately set about to re-establish the plant.

HARRIMAN, TENN.—The city is being asked to consider sale of the electric light plant and water system to raise funds by which the city debt can be paid off. There is much discussion of the proposition, and it is said it may come to a vote.

MOBILE, ALA.—A special election has been called for March 13 in this city when the voters will ballot on the question of whether or not the city shall issue bonds amounting to $160,000 for the erection of a municipal electric light and power plant.

POND CREEK, OKLA.—The city is considering plans for extension of electric light plant and water works. Address mayor.

WESTERN STATES.

BOX ELDER, MONT.—The town council has appointed a committee of three to confer with nearby power companies regarding the extension of power and light lines into this city. Dr. J. W. McKenzie heads the local committee.

CHINOOK, MONT.—F. R. Hobbins, representing the Montana Power Company, of Great Falls, Mont., is authority for the statement that the Montana Power Company contemplates purchasing the local steam power plant and closing it down, extending its power transmission system from Havre to this city. A deal is being negotiated for the purchase of the local plant at this time, and if it is put through the extension from Havre will be made immediately.

POCATELLO, IDA.—It is reported that William H. Jackson, Jr., city clerk, will, in the near future, receive bids for the installation of a street cluster lighting system on portions of Main and Center Streets, known as Local Improvement District No. 11. The city engineer is preparing plans for the installation at this time.

NOGALES, ARIZ.—The application of the Nogales Electric Light Company for a franchise in this city will be voted upon at a special election to be held on March 15.

TOMBSTONE, ARIZ. — Mayor Kuchbecker has called a mass meeting to discuss plans for a municipal electric light and power plant. His plan was favored, and the city council will take steps immediately to have a survey made and estimates prepared as to the cost of the installation.

ALBION, WASH.—A committee has been appointed by the city council to investigate the feasibility of a municipal electric light plant.

COLFAX, WASH.—It has been reported that the Elberton Building and Power Company, of Elberton, 13 miles from this city, has been granted a lighting franchise, for 50 years, by the city council. Charles N. Hinchcliff, head of the company, owns a large flouring mill in Elberton, and he states that his company will erect a power plant capable of developing sufficient power to supply current to operate his flour mill and supply this city and Elberton with current for lights. Unofficial reports state that active construction of the power project will begin this spring.

PRESCOTT, WASH.—The engineering firm of Freuler & Byer, of Walla Walla, has submitted a proposition for the installation of an electric light plant in this city.

SPOKANE, WASH.—Development of the largest power site in western United States, which, when completed on the Pen d'Oreille River between Metaline Falls, Ida., and the Canadian boundary, will cost $10,000,000, hangs on the passage of the Ferris water-power bill, now before the United States Senate. Wilbur S. Yearsley, of this city, who controls the International Power and Manufacturing Company, which concern's finances are said to be assured by the largest interests of the nation, states that work will begin just as soon as the passage of the bill is announced. More than 200,000 horsepower will be developed at a cost of $6,000,000, and the erection of subsidiary stations in connection with the main plant will bring the total expenditure well over $10,000,000.

TACOMA, WASH.—Mayor Fawcett has been instructed by the city council to use every effort to prepare the city against an inevitable shortage of electrical power during the coming fall, due to the increasing demand for municipal power and the shortage of water in the Nisqually River which furnishes the power for the municipal plant at Nisqually. While the city-owned plant has a capacity of 24,000 horsepower, the Nisqually River, in the fall, especially, will not furnish enough water to develop this capacity. The propositions of installing a steam auxiliary in Tacoma or of connecting up the municipal plant of Seattle with the Tacoma plant has been discussed. The City of Seattle, according to officials of that city, stands ready at any time to build a transmission line to the city limits of Tacoma, so that the two plants linked together would serve as an auxiliary, one to the other. O.

WALLA WALLA, WASH.—Business men conducting establishments on Second Street, from Main Street to the T. S. Steel garage, recently petitioned the city commissioners for a cluster lighting system. Reported the council will make the improvement. The district named covers an important section of the business district.

PORTLAND, ORE.—City Commissioner Dieck, by request of the city council, is investigating the cost and practicability of installing electric street signs at street intersections in the business streets, to take the place of the present system. In all likelihood, if the expense is not too great, the improvement will be made. Address City Auditor Barbour for further information.

McARTHUR, CAL.—R. McArthur has been granted a franchise to construct an electric power plant in this town.

OAK PARK, CAL.—The Business Men's Association has renewed its efforts to get an electrolier system installed in the business district. F. Hunt is investigating the cost.

PORTERVILLE, CAL.—Jos. Richardson, N. H. Leggett and J. H. James have been appointed as a committee to take up with property owners in the business district the proposition of lighting that part of the city by means of an electrolier system.

RIVERSIDE, CAL.—Plans are being prepared by the city engineer for an ornamental lighting system in the eastern part of town.

PROPOSALS.

LIGHTING FIXTURES.—Sealed proposals will be received by the Board of Administration in its office in the Capitol Building, Springfield, Ill., until March 8, for furnishing electric lighting fixtures for the employees' building at the Kankakee State Hospital, Kankakee, Ill., and the employees' building at the Elgin State Hospital, Elgin, Ill. Address Frank D. Whipp, fiscal supervisor.

ELECTRIC LIGHT PLANT.—Sealed bids will be received until March 9, for electric light plant and distribution system, as set forth in the plans and specifications prepared by Engineer W. H. Grover, of Ames, Ia. Specifications on file in office of city clerk. Bids will be considered on the city distribution system, building, steam plant, per these sections, or total. Address Joseph Dorweiler, mayor.

GENERAL SUPPLIES.—Sealed proposals for furnishing materials, supplies, and equipment for use by the executive departments and independent Government establishments in Washington during the fiscal year beginning July 1, 1915, and ending June 30, 1916, will be received by the General Supply Committee at its office in Washington, D. C., until March 10. The materials, supplies and equipment described in the General Schedule of Supplies are divided into 20 classes, of which Class 6 covers electrical engineering and plumbing supplies; Class 15, incandescent electric lamps (special Form A); Class 17, motor trucks (special Form A); Class 19, electric service; Class 20, telephone service.

FOREIGN TRADE OPPORTUNITIES.

[Addresses may be obtained by writing (mentioning file numbers) to the Bureau of Foreign and Domestic Commerce, Washington, D. C., or to the nearest of its branches at Boston, New York, Atlanta, Chicago, New Orleans, Seattle and San Francisco.]

NO. 15,627. TOOLS AND MAGNETOS.—A manufacturers' agent in Australia has informed an American consular officer that he wishes to get into communication with American firms handling or manufacturing tools and magnetos. It is stated that the agent wishes to submit bids for Government business. American reference is given.

NO. 15,649. ELECTRIC AND PHOTOGRAPHIC SUPPLIES.—A business man in Russia requests an American consul to put him in communication with American firms with a view to purchasing electric and photographic supplies. Correspondence should be in Russian or French.

NO. 15,650. ELECTRICAL SUPPLIES, AND MACHINERY OF ALL KINDS.—A Russian merchant in the Far East has informed an American consular officer that he desires to receive catalogs, price lists, export discounts, etc., and wishes to be informed as to the probable time of delivery of electrical supplies, and machinery of all kinds.

NO. 15,654. ELECTRIC-LIGHT FIXTURES, ETC.—A firm in Denmark has requested an American consular officer to put it in touch with American firms which are in a position to supply electric-light fixtures and fixtures suitable for gas and acetylene lighting. Correspondence may be in English.

NO. 15,662. EECTRICAL AND HYDRAULIC POWER MACHINERY, ETC.—A business man in the United States has written the Bureau of Foreign and Domestic Commerce that a friend in the Near East wishes to get in touch with manufacturers of electrical and hydraulic power plants, flour-milling machinery, gasoline boats, and gasoline engines. It is stated that it is desired to utilize water falls for the purpose of creating energy for a power and light plant.

NEW INCORPORATIONS.

NEW YORK, N. Y.—The Six-in-One Fuse Company, Incorporated, Manhattan, manufacturing electric device, etc.; capital $100,000. Incorporators: C. C. Balassa, J. P. Payor and J. Carl Becher.

NASHVILLE, TENN.—Sevierville Light and Power Company, Sevier County; capital, $10,000; incorporators, Stanley McMahan, A. J. Denton, Moses Gamble, Mrs. Kate C. McMahan and Mrs. Rose Emert.

DAYTON, O.—The Universal Electrical Equipment Company has been incorporated with a capital stock of $50,000, by Edward E. Burkhart, Louis B. Williams, Carl F. Brockway, S. R. Prugh and Harry Croninger, for the purpose of manufacturing electrical specialties. It will equip a factory in Dayton very shortly.

NEW YORK, N. Y.—Mesinger-Whitney Electric Company, Incorporated; to manufacture electrical appliances, etc. Capital $50,000. Incorporators: Henry Mesinger and Frederick Mesinger, of Bronx, New York, and Perrin B. Whitney of New York City.

FINANCIAL NOTES.

The Central Maine Power Company, which does an electric lighting, power, gas and street-railway business in the Kennebec Valley, has sold to Bond & Goodwin, New York City, $600,000 three-year six-per-cent notes to be offered at par. The notes are to refund a like amount of five-per-cent notes, which mature May 1, 1915.

At the annual meeting of the Mahoning & Shenango Railway & Light Company, the principal operating subsidiary of Republic Railway & Light Company, retiring directors and officers were re-elected. The action of the directors in decreasing the capital stock of subsidiaries $4,500,000 in 1914 was approved.

Dividends.

	Term	Rate	Payable
C. Miss. V. El. Prop. pf.	Q	1.5 %	Mch. 1
Col. Ry. & Lt.	—	0.75%	Feb. 25
Elec. Storage Bat.	Q	1 %	Apr. 1
Elec. Storage Bat. pf.	Q	1 %	Apr. 1
Mid. West Util. pf.	Q	1.5 %	Mch. 1
Wash. Ry. & Elec.	Q	1.75%	Mch. 1
Wash. Ry. & Elec. pf.	Q	1.25%	Mch. 1
Wis.-Minn. Lt. & Pr.	Q	1.75%	Mch. 1

Reports of Earnings.

PORTLAND RAILWAY, LIGHT & POWER.

	1914	1913
December gross	$ 514,493	$ 607,476
Net after taxes	259,010	331,604
Surplus after charges	76,036	156,121
12 months' gross	6,273,171	6,723,742
Net after taxes	3,009,288	3,425,432
Surplus after charges	836,610	1,416,830

WASHINGTON WATER POWER COMPANY.

Washington Water Power Company for the year ended December 31, 1914, reports income account as follows:

	1914	1913
Gross earnings	$2,976,425	$2,914,950
Oper. exp. and taxes	1,362,597	1,291,673
Net earnings	1,613,827	1,623,277
Bond interest	254,092	259,219
Other interest	144,853	2,975
Amort. and bond prem.	10,624	10,666
Uncollected accounts & customers dep. int.	7,978	8,572
Replacement reserve	325,000	325,000
Credit by int. on work under construction	223,167	92,346
Net income	1,094,445	1,143,913
Dividends paid	1,094,863	1,126,552
Deficit	417	*17,361
Surplus December 31	1,118,688	1,119,105

*Surplus.

MACKAY COMPANIES.

The Mackay Companies has issued its report for the year ended January 31, 1915. The income account compares as follows:

	1915	1914
†Income	*$4,246,014	$4,202,413
Preferred dividends	2,000,000	2,000,000
Common dividends	2,069,020	2,069,020
Operating expenses	60,585	30,588
Surplus	116,410	102,806

*Equal to 5.42 per cent on $41,380,400 common stock after allowing four per cent on $50,000,000 preferred stock, as against 5.32 per cent on same stock previous year.

†Income from investments in other companies. The income of the subsidiary companies of the Mackay Companies is greater than is required to pay the dividends of the Mackay Companies, but its policy is to obtain from them only enough money to meet those dividends.

NEW YORK TELEPHONE COMPANY.

The report of the New York Telephone Company for the year ended December 31, 1914, compares as follows:

	1914	1913
Phone revenue	$47,295,088	$46,831,034
Expenses and taxes	37,136,043	34,834,428
Net telephone earnings	$10,159,045	$11,996,606
Dividends and interest	5,542,073	5,770,395
Miscellaneous earnings	474,622	15,278
Total net earnings	$16,175,741	$17,782,279
Interest charges	3,460,199	3,494,695
Balance	*$12,715,542	$14,287,584
Dividends	10,000,000	10,000,000
Surplus	$ 2,715,542	$ 4,287,584

*Equal to 10.17 per cent on $125,000,000 capital stock, against 11.43 per cent on same stock previous years.

President U. N. Bethell says: "It seems proper to call attention to the fact that altogether the franchises, rights and privileges owned by your company are assessed and taxed as property, the New York City franchise alone being assessed for the year of this report at $38,878,949, the company has not included any part of the value of such franchises, rights or privileges in its assets as shown in this report. Neither has it included therein going value, the appreciation in value of real estate or the value of other forms of intangible property.

"On December 31, 1914, there were 1,154,905 stations in the system directly operated by your company and its local connecting companies, an increase during the year of 72,140. Including the associated and connecting companies, there were in service in the whole system at the end of the year 2,050,603 stations, an increase during the year of 119,198 stations."

PHILADELPHIA RAPID TRANSIT.

	1915	1914
January gross	$ 1,998,395	$ 2,006,527
Net	824,637	804,470
Surplus after charges	12,224	1,789
Seven months gross	13,943,518	14,246,064
Net	5,871,039	5,907,973
Surplus after charges	210,671	309,131

PERSONAL MENTION.

MR. A. L. KENYON, of St. Louis, Mo., has succeeded Mr. W. R. Hall as manager of the Anniston (Ala.) Electric and Gas Company.

MR. DUNCAN A. MACKENZIE has been appointed manager of the Union Electric Company, manufacturers of standard electrical specialties, Trenton, N. J.

MR. C. M. BALDWIN, formerly with D. Elmer Roberts, of Racine, Wis., has been appointed to a position in the fixture department of the Northern Electrical Company, Duluth, Minn.

MR. ANTOINE BOURNONVILLE, connected with the business of the late Alfred F. Moore for many years, has resigned. It is announced that the business of the company will be conducted as heretofore by the trustees of the estate.

MR. F. S. HARTZELL, formerly in the Salt Lake office of the General Electric Company, has taken a position with the Electric Company of Missouri, with offices at Webster Grove, under Mr. C. S. Buttner, general manager of the company.

MR. LOUIS KOVACS, of Chicago, has received from the American Institute, New York City, a diploma for the safety fuse and cutout switch which he has invented. These were described in the ELECTRICAL REVIEW AND WESTERN ELECTRICIAN March 29, 1913.

MR. FRANK W. SMITH, past-president of the Electric Vehicle Association of America, was tendered a complimentary dinner by the officers of that association on February 15, in appreciation of his efforts to further its work. The dinner was given at Delmonico's, New York City, and speeches were made by John F. Gilchrist, John W. Lieb and James H. McGraw, as well as by Mr. Smith.

PROF. H. E. CLIFFORD, of the electrical engineering department of Harvard University, has been selected by Mayor Curley of Boston to study the city's street lighting contract, recently executed with the Edison Electric Illuminating Company, and to determine as to its fairness,

CLOSING BID PRICES FOR ELECTRICAL SECURITIES ON THE LEADING EXCHANGES AS COMPARED WITH THE PREVIOUS WEEK.

	Feb. 22	Feb. 15
American Tel. & Tel. (New York)	118¾	120⅛
Commonwealth Edison (Chicago)	136½	136
Edison Electric Illuminating (Boston)	257	257
Electric Storage Battery common (Philadelphia)	*48	48½
Electric Storage Battery preferred (Philadelphia)	*48	48½
General Electric (New York)	141½	142
Kings County Electric (New York)	119	119
Massachusetts Electric common (Boston)	7	—
Massachusetts Electric preferred (Boston)	—	43½
National Carbon common (Chicago)	124	130
National Carbon preferred (Chicago)	—	—
New England Telephone (Boston)	136	136
Philadelphia Electric (Philadelphia)	*24⅛	23⅞
Postal Telegraph and Cables common (New York)	76	73⅝
Postal Telegraph and Cables preferred (New York)	—	67
Western Union (New York)	62⅛	63½
Westinghouse common (New York)	66¾	70½
Westinghouse preferred (New York)	117	117

*Ex-dividend.

with a view to submitting the question of prices to the State Gas and Electric Light Commission, as provided in the contract.

MR. JOHN H. PETERSON, manager of the new-business department of the Menominee and Marinette Light & Traction Company, has left Menominee for an extended trip to the West Indies. Mr. Peterson goes to take a rest from his work and expects to be absent two or three months. He expects to spend considerable time in Cuba and Porto Rico, visiting the Panama Canal on his return.

MR. T. H. ENDICOTT, formerly manager of the Indianapolis office of the Crocker-Wheeler Company, is now connected with Walker Brothers & Haviland, Monadnock Block, Chicago, who are general sales agents for The Industrial Controller Company (formerly Independent Electric Manufacturing Company), of Milwaukee, Wis. Mr. Endicott is in charge of the Chicago district sales for this department of Walker Brothers & Haviland.

MR. J. G. DE REMER, formerly connected with the United Light and Power Company, San Francisco, Cal., has been appointed to the management of the general engineering department of the American District Steam Company, North Tonawanda, N. Y. Mr. De Remer will specialize in plant efficiency, making inspections, repairs, tests and recommendations looking to obtaining the greatest efficiency in the operation of central-station heating systems now in operation, as well as future installations.

MR. C. W. WHITLEY, of Salt Lake, one of the best known and most prominent business men and financiers in the west, is the new president of the Utah Light and Traction Company. Mr. Whitley was elected president at a meeting of the board of directors of the traction company, held February 18. It was the first meeting of the new board of directors elected at the recent meeting of the stockholders of the Utah Light and Traction Company. Mr. H. L. Beach, of Chicago, has been elected manager of the company, effective at once. Mr. Joseph S. Wells, who was formerly manager of the company, is now secretary and treasurer of the company. All the new officers took up their duties at once. Mr. Wells, in addition to being elected secretary and treasurer of the company, is also named as director. Mr. Beach, the new manager of the Utah Light and Traction Company comes to Salt Lake with an excellent reputation as a most effective traction official. He has had extended experience as an official of the city lines in Chicago for many years, and in Kansas City, Toronto and other cities. He was recently a traction expert for Bion J. Arnold. Mr. Beach, previous to his traction experience was an employe in the editorial department of the Chicago *Tribune*.

OBITUARY.

MR. DAVID G. HAMILTON, for 10 years president of the Chicago City Railway Company and with extensive interests in traction companies in other cities, died at his home in Chicago, on February 16. Mr. Hamilton was 73 years of age and was a trustee of the University of Chicago. He had been prominent for years in many civic enterprises. He was president of the National Railway of Illinois and its seven subsidiary companies from 1889 until 1899, and was president of the Texas & Central Mexican Railway. Mr. Hamilton was a director of the Union Mutual Life Insurance Company of Maine, the Farmers and Mechanics' National Bank of Fort Worth, Texas, a member of the Chicago Historical Society; a trustee of De Pauw University; a member of the Knights Templar, and a thirty-second degree Mason. He belonged to the Chicago and Union League Clubs.

MR. H. WARD LEONARD, electrical engineer and inventor, for many years one of the most prominent figures in the development of many phases of the electrical industry, died suddenly at the Hotel Astor, New York, on the evening of February 18, while attending the mid-winter dinner of the American Institute of Electrical Engineers. Mr. Leonard was born in Cincinnati, O., February 8, 1861. He was graduated from the Massachusetts Institute of Technology, and when 23 years of age became associated with Thomas A. Edison as a member of Mr. Edison's staff of four engineers selected to introduce the Edison central-station system. Three years later he was made the general superintendent of the Western Electric Light Company in Chicago. A year later he formed the firm of Leonard & Izard, of Chicago, a concern which made many important instal-

H. Ward Leonard.

lations of central-station plants and electric railways in many parts of the country. In 1889 the firm was bought out by the Edison interests, and Mr. Leonard became general manager of the light and power departments of the combined Edison interests for the United States and Canada, with headquarters in New York City. In 1891 Mr. Leonard resigned this latter position to establish his own independent manufacturing business, which is still operating as the Ward Leonard Electric Company at Bronxville, N. Y. Mr. Leonard had not taken an active part in the affairs of the company for a number of years, having busied himself with experimental work and in the development of his many inventions. His first inventive work was electric lighting for railway trains, which he put into commercial operation in 1888. In 1891 he completed his inventions of the Ward Leonard system of motor control, and the following year his multiple voltage system. The value of the Ward Leonard system of control was demonstrated during the Spanish-American War, when it was used in one turret of the *Brooklyn*. After the war it was generally adopted by the United States navy, and all of the ships are equipped with it with only a few exceptions. Mr. Leonard also invented the Ward Leonard double-arm circuit-breaker, a system of regenerative braking, the Ward Leonard single-phase railway system, a compound controller for the control of electric motors operating machine tools, and an invention applicable to automobiles, a change gear, which is now in general use. His system of motor control was applied to the moving sidewalk at the Paris Exposition in 1900 after many attempts to operate it by other systems. He was a contributor to many technical papers and delivered a number of addresses to scientific bodies. For work along electrical research, the Franklin Institute of Philadelphia, in 1903, conferred upon Mr. Leonard the John Scott medal, while he also was awarded the gold medal at the Paris Exposition in 1900, and at the St. Louis Exposition in 1904. He had been vice-president and also manager of the American Institute of Electrical Engineers, of which he had been a member since 1887. He was also a member of the Inventor's Guild, the Union League Club, the Engineers' Club, the Clove Valley Rod and Gun Club, the New York Electrical Society, and the Technology Club of New York. He had been president of the village of Bronxville, where he lived, and was a director of the Mount Morris Bank of New York.

DATES AHEAD.

"Made in the U. S. A." Industrial Exposition. Grand Central Palace, New York City, March 6-13. President, H. A. Cochrane, Fifth Avenue Building, New York, N. Y.

New England Section, National Electric Light Association. Question Box convention, American House, Boston, Mass., March 11-12. Secretary, Miss O. A. Bursiel, Boston, Mass.

Electrical Supply Jobbers' Association. Spring meeting, Hotel La Salle, Chicago, Ill., March 17-19. Secretary, Franklin Overbagh, 411 South Clinton Street, Chicago, Ill.

American Institute of Electrical Engineers. Industrial Power meetings, Cleveland, O., March 18-19; Pittsburgh, Pa., April 15-16. Secretary, F. L. Hutchinson, 33 West Thirty-ninth Street, New York, N. Y.

Minnesota Electric Association. Annual meeting, St. Paul, Minn., March 23-25. Secretary, F. A. Otto, St. Paul Gas Light Company, St. Paul, Minn.

National Association of Electrical Inspectors. Annual convention, Hotel Martinique, New York City, March 23-25. Secretary, W. L. Smith, Concord, Mass.

Electrical Committee, National Fire Protection Association. Annual meeting, New York City, March 24-25. Secretary, Ralph Sweetland, 141 Milk Street, Boston, Mass.

Mississippi Electric Association. Annual meeting, Hattiesburg, Miss., April 12-14. Secretary, H. F. Wheeler, Hattiesburg, Miss.

Iowa Section, National Electric Light Association. Annual convention, Keokuk, Iowa, April 20-22. Secretary, W. H. Thomson, Jr., Des Moines, Iowa.

American Electrochemical Society. Annual meeting, Atlantic City, N. J., April 22-24. Secretary, J. W. Richards, South Bethlehem, Pa.

Southwestern Electrical and Gas Association. Annual convention, Galveston, Texas, May 19-21. Secretary, H. S. Cooper, Dallas, Tex.

National Electric Light Association. Annual convention, San Francisco, Cal., June 7-11. Secretary, T. C. Martin, 29 West Thirty-ninth Street, New York.

With the Electrical Manufacturers

Kerr Turbine Company, Wellsville, N. Y., announces the appointment of John S. Huey, 418 Hibernia Bank Building, New Orleans, La., as its district sales agent for the states of Louisiana and southern Mississippi. Mr. Huey was formerly connected with the Allis-Chalmers Company, and more recently with Woodward, Wight & Company.

The Robbins & Myers Company, Springfield, O., has issued in convenient booklet form a condensed catalog of its "Standard" electric fans. It gives the most important data of the many types of ceiling fans, desk and bracket fans, oscillating fans and exhaust fans made by the company, which has been manufacturing electric fans for about 19 years. An attractive cover adds interest to this handy publication.

The Mechanical Appliance Company, Milwaukee, Wis., has issued a very attractive bulletin entitled "What Makes Them Run." It shows some of the many classes of machines that are run by the company's Watson motors. A few views are shown of some of these motors and parts thereof. A large number of motor applications are shown and briefly described. All of the illustrations are high-class cuts and the entire bulletin is gotten up in an effective manner.

National Tube Company, Pittsburgh, Pa., has devoted the February number of its monthly National Bulletin to "The Rise of Steel Pipe." A number of articles are reproduced, and illustrations shown that demonstrate graphically how steel pipe is rapidly superseding wrought-iron pipe. In 1887 steel pipe constituted less than 1 per cent of the entire output of wrought pipe in this country; in 1913 it had risen to between 85 and 90 per cent of the entire output. The significance of this is pointed out in the articles published.

The Cutler-Hammer Manufacturing Company, Milwaukee, Wis., has published a folder entitled "An Inquiry and the Answer." The inquiry referred is from a central-station man, who tells of having considerable socket trouble, owing to the use of defective heating appliances, and who asks whether he can be safe in recommending the C-H push-button, 660-watt socket to his customers for use with electric irons and other table devices. The answer by the manager of the C-H specialty department is reproduced, showing that this socket is peculiarly suitable for just such service.

George Cutter Company, South Bend, Ind., has ready for distribution its new catalog No. 13 on street and industrial lighting fixtures. The catalog has 64 pages with several hundred illustrations of typical fixtures and auxiliary street-lighting equipment, particularly pole-line and lamp-mounting material. Each type of fixture is described and full data are given of various sizes and forms. Distribution curves of many of the fixtures are reproduced. A unique feature of the catalog is in showing modified forms of the several types close together, so as to show clearly the interchangeability of parts in assembling other forms to meet exactly any conditions. Many of the fixtures are designed especially to suit the new gas-filled tungsten lamps for both exterior and interior lighting. Aside from a great variety of street hoods and pendent fixtures there are shown and listed numerous designs of ornamental street posts, both of the single-unit and cluster types.

Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa., has recently issued the following new publications: Leaflet 3751 describes the construction and purpose of current-limiting reactance coils, illustrating same both in the completed and construction stages; this type of apparatus has recently come into prominent use owing to the increased capacities of generating units. Folder 4226 explains in a popular manner some of the many advantages to be gained by the manufacturer from the use of electric power; a number of illustrations of the application of electric power to the different industries are shown. Folder 4205 describes Westinghouse-Cooper Hewitt rectifiers for moving-picture service, showing the advantages of direct current for this class of work and describing the rectifier and its operation. Folder 4152-A shows the advantages to be gained by the seamstress from using the electric motor; illustrations are given showing the method of mounting the different types of motors on sewing machines. Folder 4266-A gives some definite data on cooking breakfast by means of the Westinghouse toaster stove and coffee percolator; these devices and the radiant toaster are also described and illustrated. Dealers' catalog, Section DS300 covers the entire line of Westinghouse Electric fans for the year 1915; the catalog is profusely illustrated and gives in considerable detail the construction and operating features of these fans. Westinghouse Railway Data Exchange, January, 1915, contains a reprint of an article from the *Electric Railway Journal* on "The Problem of Old Motors," also one by Elbert Hubbard on three-cent fares; a number of views of Westinghouse railway motors are given, together with their more important characteristics; an insulating varnish spray is also described. Descriptive leaflet 3698-A covers motors for linotype and intertype machines in which the class of motors designed for this application is described and illustrated. Descriptive leaflet 3770 deals with Westinghouse cam limit switches, which find a ready adaptation to elevators, skip hoists, mine hoists, steel-mill machinery and wherever it is necessary to confine the travel of a moving mechanism within certain predetermined limits. Small motors No. 22 is devoted to a description of Westinghouse type AR single-phase motor; complete and detail views of this type of motor are shown and its characteristics thoroughly described. "The A B C of Automobile Battery Charging" covers in a complete and concise manner the use of rectifier outfits for charging storage batteries; the accessories, such as time switches, meter panels are also described and illustrated. Electric-vehicle battery charging by means of motor-generator sets is also thoroughly described and illustrated by means of leaflet 3679, in which special mention is made of the switchboard designed for this class of work.

Record of Electrical Patents.

Issued by the United States Patent Office, February 16, 1915.

1,128,279. Electric-Wave Amplifier. H. D. F. Arnold, assignor to Western Electric Co. Repeating apparatus comprises two Audion elements in a unit structure with two filaments, two grids between them and a common anode plate between the grids.

1,128,280. Thermionic Detector. H. D. F. Arnold, assignor to Western Electric Co. Includes a pair of input electrodes similarly connected to the negative side of the input current and oppositely connected to the circuit whose current is to be detected.

1,128,292. Electric-Wave Amplifier. E. H. Colpitts, assignor to Western Electric Co. Modification of No. 1,128,279.

1,128,307. Illuminating Door Knob. C. A. Greely, Oakland, Cal. Push-button and electric lamp in knob and battery in door.

1,128,313. Process of Separating Copper from Nickel and Matte and other Products. N. V. Hybinette, assignor to National Trust Co., Ltd., Toronto, Canada. Consists in subjecting a slab of copper-nickel matte to electrolytic action and then depositing copper on the slab by cementation and simultaneously dissolving nickel from the slab.

1,128,314. Process of Producing Copper-Nickel Anodes. N. V. Hybinette, assignor to Pacific Securities Co., Ltd. Consists in leaching the oxides with dilute sulphuric acid, electrolyzing the solution for recovery of copper, crystallizing for removal of nickel, smelting the mixture and casting anodes.

1,128,315. Process of Circulating Solution for Electrolysis. N. V. Hybinette, assignor to Pacific Securities Co., Ltd. Consists in passing the electrolyte alternately into into the bottom and top of the cathode compartment.

1,128,316. Anode for Electrolysis. Noak Victor Hybinette, assignor to Pacific Se-

curities Co., Ltd. Consists mainly of nickel, copper and 4 to 8 per cent sulphur and has an electrolytically treated surface.

1,128,366. Electrical Heating Device. E. H. Ruckle, assignor to Hughes Electric Heating Co., Chicago, Ill. Hot plate for disk stove with resistance wire in parallel channels on top, except in center.

1,128,383. Single-Spark Apparatus for Internal-Combustion Engines. E. W. Stevens, assignor to Webster Stevens Electric Co., Cleveland, O. Special induction-coil arrangement.

1,128,384. Floor-Cleaning Machine. E. J. Stewart, New York, N. Y. Electrically driven scrubbing machine.

1,128,405. Testing Apparatus for Meters. L. R. Brooks, Pittsburgh, Pa., assignor of one-half to C. W. Ward. Separable terminal post to permit connection of test instruments.

1,128,422. Printing-Telegraph Receiver. A. F. Dixon, assignor to Western Electric Co. Includes a rotary current distributer, selecting relays and selecting magnets.

1,128,424. Insulator. J. D. E. Duncan, East Orange, N. J.; L. E. H. Duncan, executrix of said J. D. E. Duncan, deceased. Superposed dome and petticoat insulators carry arcing points.

1,128,427. Method for Treating Molds Used in the Art of Electrotyping. G. E. Dunton, New York, N. Y. Forms a coating of insulating material over back of molding pan and margins surrounding the face of mold.

1,128,439. Signal-Controlling Means for Railway Gates. J. A. Gasse, Claremont, N. H. Electrically actuated signals.

1,128,453. Device for Placing Electric Globes in Sockets. F. A. Johnson, Danville, Ill. Bulb-gripping arms mounted on top of pole and controlled from lower portion.

1,128,469. Automatic Telephone Exchange. G. W. Lorimer, assignor to Western Electric Co. Main starting switch controls subsidiary switches.

1,128,481. Amalgamating or Plating Machine. C. G. Miller, Chicago, Ill., assignor to Meaker Co. Electroplating tank.

1,128,492 and 1,128,493. Telautographic Apparatus. H. W. O'Neill, assignor to Gray National Telautograph Co., New York, N. Y. In first patent a condenser is shunted around D. C. generator to bypass any A. C. generated. Second patent provides interrupter, condenser and impedance at the transmitter for converting D. C. into A. C. waves and directing such waves to the receiver to vibrate the pen-moving parts.

1,128,498. Safety Apparatus for Railway Systems. A. Pecorella, Buffalo, N. Y. Each train carries signal generator controlled by track contacts.

1,128,515. Welding-Piece for Electrically Welded Metal-Work. A. F. Rietzel, assignor to Universal Electric Welding Co., New York, N. Y. Welding blank adapted partially to enter a hole in the two pieces to be united when inserted between them.

1,128,518. Automatic Vending-Machine. C. J. Rohland, New York, N. Y., assignor to Hobbs Mfg. Co. Has solenoid-controlled feeding mechanism.

1,128,552. Detector. F. B. Turner, Huntington Beach, Cal. Crystal wireless detectors arranged in cups around central rotary contact spindle.

1,128,554. Electric Heater. W. B. Underwood, assignor to American Sterilizer Co., Erie, Pa. Has two resistor coils and a connector lead between them.

1,128,562. Electromagnet. H. G. Webster, assignor to Kellogg Switchboard & Supply Co., Chicago, Ill. Telephone relay.

1,128,568. Railway-Switch or the Like. C. O. Anderson, assignor of seven-tenths to A. T. Austin and three-tenths to W. A. Austin, Omaha, Nebr. Electrically operated controlling mechanism.

1,128,570. Railway Switch Operating Mechanism or the Like. W. A. Austin, Omaha, Nebr., assignor of one-half to A. T. Austin. Electrical mechanism remote from the switch.

1,128,580. Spark Plug. W. S. Brown, Belvidere, Ill. Has spring sleeve.

1,128,582. Automatic Stop. V. H. Carman, Indianapolis, Ind., assignor to Carman & Fryer. Multiple-contact knife switch with stops to hold switch in intermediate position where it engages the lower contacts only.

1,128,600. Electrical Type-Telegraph. F. C. Grasmé, Hoboken, N. J. Electromagnetically operated strip-printing and feeding device.

1,128,606. Suspender for Electric Cables or the Like. P. Huntington, Liverpool, England. Cable hanger formed of double band.

1,128,630. Vacuum Cleaner. J. W. Smith, assignor to Santo Mfg. Co., Philadelphia, Pa. Motor inclosed in lower compartment.

1,128,640. Electric Furnace and Process of Heating Substances Uniformly and at a Controllable Temperature. E. F. von Wilmowsky, deceased, by E. J. Prindle, executor, assignor to Norsk Hydro-Elektrisk Kvaelstofaktieselskab. Mixed gases are passed repeatedly in contact with an electric arc.

1,128,644. Lighter for Gas Stoves. T. L. Wiese, Milwaukee, Wis., assignor of one-third to J. Froelich and one-third to L. E. Lamfrom. Electric igniter for multiple-burner stove.

1,128,646. Telephone Exchange System. J. L. Wright, assignor to Frederick C. Stevens, Attica, N. Y. Special ringing relay and control therefor.

1,128,660. Call Distributing Telephone System. H. P. Clausen, assignor to Western Electric Co. Includes automatic traffic-distributer switches.

1,128,666. Apparatus for Treating Molds used in the Art of Electrotyping. G. E. Dunton, New York, N. Y. Modification of No. 1,128,427.

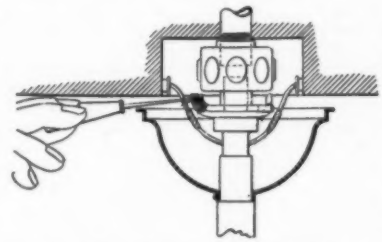
1,128,687. Apparatus for Speed Control for Lathes. H. Kienzle, New York, N. Y. Upon advance of turret speed of work spindle is electrically varied.

1,128,690. Electric Riveting Machine. C. Knoth, Newark, N. J., assignor to Hyatt Roller Bearing Co. Has means for adjusting the pressure of the hubs in sockets to form a perfect movable electric contact.

1,128,692. Motor-Controller. C. J. Kruse, assignor to Cutler-Hammer Mfg. Co., Milwaukee, Wis. Has circuit-breaker to cut off armature from line when it begins to act as a generator.

1,128,701. Central-Station Switching Apparatus for Automatic Telephone Systems. F. A. Lundquist and J. J. Brownrigg, assignors to Western Electric Co. Includes a buzzer for automatically indicating busy condition.

1,128,726. Iron Alloy. W. Rübel, Charlottenburg, Germany. For electrical cores; contains iron of 99.5 per cent purity and a mixture containing 1 to 2 per cent aluminum and 0.8 to 1.2 per cent silicon.



No. 1,129,024.—Fixture Mounting.

1,128,731. Electric Heating Device. E. B. Spencer, Kenmore, N. Y. Includes electromagnetic holding device.

1,128,739. Attachment for Firearms. A. Weigel, Berlin, Germany. Battery, switch and sighting lamp.

1,128,744. Push-Button. W. W. Barcy, Jr., assignor to Wil Bar Mfg. Co., Detroit, Mich. Details of construction.

1,128,747. Method of Manufacturing Porcelain Insulators. W. Boehm, Charlottenburg, Germany. Consists in forming the porous unglazed porcelain, filling the pores with a mixture of oxidizing oil and powdered material, and treating with ozone.

1,128,751. Time-Indicator. C. H. Brown, Detroit, Mich. A clock-rotated hand closes adjustable circuit contacts on a dial and rings a bell to denote beginning and termination of an operation.

1,128,764. Fuse. E. G. Davis, Paris Crossing, Ind. Fastening of fuse element to ends of cartridge fuse.

1,128,777. Telephone System. C. E. Hague, assignor to Western Electric Co. Includes means to cause all of the private conductors to a particular operator's position to test busy whenever two unanswered calls are simultaneously received at this position.

1,128,802. Motor-Vehicle Frame. A. W. Medhurst, assignor to Anderson Electric Car Co., Detroit, Mich. Motor-supporting frame intermediate side sills.

1,128,817. Valve-Detector for Wireless. G. W. Pickard, assignor to Wireless Specialty Apparatus Co., Boston, Mass. Of Edison-effect type; comprises hot and cold terminals, a conducting sheath inclosing them and a conductor connected to the sheath.

1,128,819. Spark Plug. A. Schmidt, assignor to Champion Ignition Co., Flint, Mich. Metallic casing.

1,128,842. Conduit Clamping-Plate and Disk. W. A. Bonnell, Brooklyn, N. Y. Has a conduit-engaging edge arranged diagonally to its axis to exert wedging action on the conduit.

1,128,857. Selective Signaling System for Party Lines. E. B. Craft, assignor to Western Electric Co. Telephone ringing system.

1,128,859. Ophthalmoscope or other Optical Instrument. H. L. De Zeng, Maple Shade, N. J. Electric lamp for illuminating indicators on the instrument.

1,128,905. Agitating Electric Amalgamator. L. St. D. Roylance, San Francisco, Cal. Relates to tank construction.

1,128,914. Magneto-Electric Generator. C. A. Stone and G. C. Brown, Buffalo, N. Y., assignors to said Stone, C. B. Moulthrop, and L. C. Jackson. Has distributor ring mounted close to collector ring and connected therewith through collector brush.

1,128,927. Telephone Repeating Device. D. H. Wilson, New York, N. Y. Local circuit inductively connected to line.

1,128,930. Telephone System. F. V. Young, assignor to Western Electric Co. Interconnection of operator's and ringing circuits.

1,128,932. Automatic Train-Stop. F. G. Bastian, Buffalo, N. Y. Electrically operated air-brake valve.

1,128,943. Telephone Relay. S. G. Brown, London, England. Small granular microphone attached to vibratory armature.

1,128,944. Electrical Relay. S. G. Brown. Modification of above.

1,128,945. Portable Electric Lamp. J. J. Brownrigg, H. Henderson and A. E. Case, assignors to Delta Electric Co., Marion, Ind. Hand lamp comprising single dry cell in casing and switch, socket, lamp, reflector and lens in upper part of casing.

1,128,956. Apparatus for Handling Electric Connector or Tapping Devices. J. M. Downs, Savannah, Ga. A pair of jaws mounted on handle with control for the movable jaw.

1,128,966. Process of Making Peroxide of Hydrogen. F. Fischer, assignor to Henkel & Cie., Dusseldorf, Germany. Consists in continuously forcing oxygen into an electrolyte under high pressure and during simultaneous generation of hydrogen by electrolysis.

1,128,978. Timer. F. C. Hersee, Roslindale, Mass. Rotating contact engages radial contacts.

1,129,001. Press. J. Nesetril, assignor to J. P. Colloredo-Mannsfeld, Dobris, Austria-Hungary. Electrically operated machine for compressing concrete railroad ties.

1,129,024. Electrical-Fixture Fitting. F. J. Smith, Montreal, Que., Canada. Fitting for fixture mounting. (See cut.)

1,129,036. Electric Motor. E. G. Hoffmann, New Rochelle, N. Y.; A. W. Kiddle and A. M. Beeker, executors of said Hoffmann, deceased. Twin motor with two separate armatures on single shaft and two fields in separate adjoining compartments of the casing.

1,129,051. Liquid-Level Register and Alarm. M. G. Crooks, Evansville, Ind. Electric alarm.

Reissue 13,880. Method of Removing Tarnish from Metals. M. H. Keyt, Chicago, Ill. Original No. 937,154, dated Oct. 19, 1909. Clean zinc and the metal are placed in contact and immersed in alkaline electrolyte.

Patents Expired.

The following United States electrical patents expired on February 22, 1915:

599,315. Secondary Battery. W. A. Crowdus, Chicago, Ill.

599,316. Electric Igniter for Gas Engines. F. E. Culver, Chicago, Ill.

599,322. Individual Telephone Call. T. C. Drake, Malta, O.

599,344. Electric Railway System. J. M. Murphy, Torrington, Conn.

599,346. Electric Wire-Holding Appliance. H. A. McCoy, Cambridge, Mass.

599,351 and 599,352. Electric Resistance Conductor. H. G. O'Neill, Brookline, Mass.

599,354. Electric Igniter for Explosive Engines. H. F. Probert, Chicago, Ill.

599,393. Trolley for Electric Railways. E. K. Landis, Philadelphia, Pa.

599,405. Electric Battery. C. P. Shrewsbury, London, and J. L. Dobell, Modbury, England.

599,455. Apparatus for Producing Ozone. M. Otto, Paris, France.

599,480. Electric Arc Lamp. O. B. Skinner and G. M. Bacon, Cleveland, O.

599,508. Driving Gear for Electric Meters. G. A. Le Fevre, New York, N. Y.

599,543. Support for Incandescent Electric Lights. J. Whitaker, Schenectady, N. Y.

599,553. Telephone Switchboard Apparatus. C. F. Dunderdale, Chicago, Ill.

599,560. Paper-Perforating Machine. F. W. Hedgeland, Chicago, Ill.

599,604. Electric Railway System. J. D. Gibbs, Chicago, Ill.

599,635. Electric Arc Lamp. H. J. Sage, Rochester, Pa.

599,654. Fire-Alarm Box. J. H. Hayes, Appleton, Wis., and C. Fisher, Chicago, Ill.